Information Technologies

and the Future of Land Warfare

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.520. laMuch of the future of land warfare will be shaped by the rapidly
expanding information technologies. In December 1993, RAND convened 18
researchers with expertise in the information sciences and military
operations to brainstorm on the ways that fast-growing communications and
computational capabilities might change the nature of conflicts, the Armys
missions, the way the Army organizes, and especially its concepts of
operations. The researchers generally agreed that the nature of conflict
is changing not so much because of technological and demographic shifts of
power. The causes, participants, and objectives in conflicts are being
transformed by the information technologies faster and more fundamentally
than the weapons are. The report concludes with six new concepts for Army
organization and operations. They span a broad range of issues: from the
primary role of the soldier on the battlefield to how the Total Army might
be organized for its disparate missions. All six concepts would imply
significant changes in Army doctrine, training, organization, and
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This report documents and expands on the principal findings of a two-day RAND workshop conceived and sponsored by TRADOC, the Army's Training and Doctrine Command, to explore the potential impacts of the rapidly expanding information technologies upon the future of land warfare. It describes changes in the information technologies, speculates on their implications for the Army's environment, and explores new concepts for Army operations and organizations. The report should be of interest to Army leaders, to developers of Army doctrine and systems, and, more generally, to military analysts and planners.

CONTENTS

On December 7, 1993, RAND convened 18 researchers with expertise in the information sciences and military operations to "brainstorm"[1] on the ways that fast-growing communications and computational capabilities might change the nature of conflicts, the Army's missions, the way it organizes, and especially its concepts of operations. The workshop began with four prepared briefings by invited experts who speculated on

- The technical dimensions of the information revolution (Anthony C. Hearn),

- How that revolution is shifting political, economic, and military power in the world (Carl H. Builder),

- The responses of commercial organizations to these changes (Paul J. Bracken), and

- The changing nature of the battlefield (Sam B. Gardiner).

Following these introductory briefings, the workshop participants devoted a half day to discussing the broad implications of these changes for conflict, land warfare, and the U.S. Army. They spent the following day speculating about concepts that might be appropriate for the Army as it adapts to and exploits the changing environment

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[1]As used here, the verb "brainstorm" means to elicit and record ideas in a collegial seminar setting, without immediate criticism or analysis, in order to encourage speculative and imaginative thinking about future possibilities. The noun "brainstorm," as a process, presumes that one uninhibited idea, when exposed to the mind of another, may trigger still another idea—in a sort of chain reaction or "storm" of ideas.

and as it works through its Force XXI experimentation process. Dozens of ideas and their variations or applications were brainstormed and discussed; all were exposed to expert opinion, but none were analyzed in any detail. The authors then extracted what they thought were the most significant and representative of these concepts for exposition here.

It should be noted that this report is about the effects of the information technologies upon future land warfare rather than about "information warfare" per se. Whereas information warfare is a discipline concerned mainly with technical C^3I and command deception issues such as computer viruses and electronic jamming/spoofing, this study has to do with some broader impacts and implications of the ongoing information revolution.

The findings of the workshop reported here are of three different kinds:

- Synopses of the four invited introductory briefings,

- Highlights from the workshop participants' observations about the changing nature of conflicts and of the Army's missions, and

- Sketches of six concepts for Army organization or operations that the participants thought might become feasible because of the rapidly expanding information technologies and capabilities.

The four introductory briefings painted a picture of sustained growth in communications and computational capabilities per unit cost over the next several decades, compounding at the rate of about 40 percent per year. These extraordinary changes are dramatically altering the sources of wealth and power on a global scale, implying significant changes in the roles of nations, the nature of conflicts, and the tasking of military forces. Commercial enterprises, after a century of following the hierarchical military models for organization, are now diverging toward much more distributed, specialized, and flexible structures. Future battlefields may reflect many of the structural changes that are now becoming evident in the information-dominated commercial markets.

The workshop participants generally agreed that the nature of conflict is changing not so much because of technological changes in the

means of warfare as because of technical, demographic, and geopolitical shifts of power. Technical shifts of power are here defined as power shifts that significantly increase the independent technical capabilities of political actors that were heretofore very weak in comparison to more traditional actors and institutions. The causes, participants, and objectives in conflicts are being transformed by the information technologies more rapidly and fundamentally than the weapons are. One of the more intriguing observations in the workshop was that warfare in the information era has come to resemble improvisational theater on a world stage, where major policy shifts can result from a single good or bad scene.

All six concepts for Army organization or operations advanced by the workshop are rooted in currently observable changes associated with the information technologies. The concepts span a broad range of issues—from the primary role of the soldier on the battlefield to how the total Army might be organized for its disparate missions:

- **Soldiers as Sensors**—the idea that soldiers may be more valuable on the battlefield as sensors than as weapons.

- **Information Carousel**—the idea that information on the battlefield may be treated as a commodity available to all upon demand and one to which all can contribute.

- **Agile Defense/Lodgment**—the idea that the holding of territory may be less important than its selective use in time and space for battle.

- **Network Army**—the idea that the Army may not need to physically move many of its resources in order to bring them to bear on the battlefield.

- **Franchised Combat Units**—the idea that communications permit the efficient organization of smaller, more numerous and autonomous units, each with a span of control defined by its maximum weapons range.

- **An Army of Armies**—the idea that the changing tasks of the Army may call for differently organized, trained, and equipped units rather than "one soldier fits all" tasking.

None of these ideas were examined in detail. The purpose of the workshop was to speculate, not analyze. It is apparent, however, that all six concepts would imply significant changes for Army doctrine, training, organization, or equipment.

The report concludes with some workshop observations on the relationships between the information technologies and the Army in a rapidly changing world. In particular, the information technologies may be shifting many of America's national security problems out of our current defense planning paradigm—one that has long emphasized the ability to fight and win large conventional wars that take place over clear issues of sovereignty and in which the enemy is an established nation-state.

ACKNOWLEDGMENTS

INTRODUCTION

The rapid development of the information technologies is changing the world in many ways. It is fundamentally altering distributions of political, economic, and military power. It is revolutionizing corporations and the ways that they organize and conduct their business. It is creating almost seamless global markets for capital and commodities. And, across all of these domains, there is evidence that the profound increases in the availability and utility of information are weakening the traditional hierarchical forms upon which the civilized world has long depended for governance, business, commerce, and social order.

The effect of these changes on the nature of conflict, warfare, and military institutions is the subject of much current speculation but little certainty because for most military institutions—unlike business and social enterprises—their endeavors, conflict and war, are sporadic rather than continuous. Military forces for the 21st century must be designed today for conflicts and wars that have not yet been—and may never be—fought; and they must be designed to be effective in environments that are still unfolding and obscure. Hence, the responses of military institutions to revolutionary changes in the information technologies are more likely to be driven by anticipatory planning and analysis than by actual combat experience.

In the fall of 1993, the U.S. Army's Training and Doctrine Command (TRADOC) suggested that RAND's Arroyo Center might conduct one or more workshops to explore some of the effects of information technologies on the future of land warfare. Implicitly, TRADOC

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sought new organizational and operational concepts for land warfare that might be lurking unseen or unheard by the Army in other minds now fully seized by the information revolution—in business organizations and the information sciences. Such new concepts, if found, might expand and inform the Army's development of Force XXI, an initiative aimed at anticipating the Army's needs—in organization, doctrine, and equipment—for the 21st century.

Dr. Paul Berenson of TRADOC pursued these goals with RAND in the last quarter of 1993. His concept for the workshops was one or more RAND-led brainstorming[1] seminars to explore how the Army might exploit the information technologies, especially those that might

- revolutionize land warfare,

- insure a warfighting edge, and

- lead to new operational concepts for major regional contingencies (MRCs) and low-intensity conflict (LIC) conditions.

Early proposals called for participants from TRADOC, RAND, and commercial enterprises to insure cross-fertilization of pertinent experiences and concepts. However, the schedule for Force XXI documentation did not allow sufficient time to coordinate participants from several different communities, so it was agreed that the initial workshop would be conducted within the RAND community of researchers and consultants, but with the broadest possible participation from relevant disciplines.

The participants in the workshop were the 18 RAND staff and consultants listed in Figure 1. They included information, political, physical, and management scientists and military operators, technologists, planners, and analysts—each discipline represented by at least two participants.[2]

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[1]For a definition of the term "brainstorm" as it is used here, see footnote 1 in the summary to this report, p. ix.

[2]Approximately half the participants had the benefit of prior experience in RAND workshops exploring advanced technology applications for the Advanced Research Projects Agency (ARPA). Two of the participants had served as U.S. Army officers; two came from outside universities; three are well-recognized experts on information warfare; one is the editor of the journal *The Information Society;* another is RAND's Resident Scholar (a chair) on information sciences; and at least a third of the participants have reputations as published futurists.

Robert H. Anderson	Kenneth P. Horn
Steven C. Bankes	Richard D. Hundley
Paul J. Bracken	Gaylord K. Huth
Carl H. Builder	Leland Joe
Edison M. Cesar	Iris M. Kameny
Bruce W. Don	Brian Nichiporuk
Sam B. Gardiner	William D. O'Malley
Elwyn D. Harris	David F. Ronfeldt
Anthony C. Hearn	Randall Steeb

Figure 1—TRADOC Workshop Participants

The explicit objectives presented to the workshop participants at the outset were twofold:

- Gain a better understanding of the military implications of the emerging information technologies—especially those that might revolutionize land warfare.

- Identify new operational concepts that might be made feasible for the Army by the emerging information technologies—for both MRCs and LIC conditions—with particular attention to such aspects as weapons mixes in combat units, operational and tactical doctrine, organizational structures, and battle management.

The workshop, under the title "Information Technologies and the Future of Land Warfare," was conducted on December 7 and 8, 1993, at RAND, Santa Monica, in four half-day sessions:

- An introductory session in which four orientation or stage-setting briefings (described below) were offered to the participants.

- A discussion of the Army's changing environment, intended to elicit and expand the participants' concepts of warfare.

- A first brainstorming session on those operational and organizational concepts judged appropriate to major regional contingencies.

- A second brainstorming session on those operational and organizational concepts judged appropriate to low-intensity conflicts.

The four introductory briefings were intended to set the stage for the workshop, orient the participants to the workshop subjects, and stimulate their thinking. In the order of their presentation, the briefings were by

- Anthony C. Hearn, RAND's Resident Scholar on the information sciences, who described the technical dimensions of the information revolution.

- Carl H. Builder, from RAND's International Policy department, who outlined how the information revolution is transforming political, economic, social, and military structures.

- Paul J. Bracken, from the Yale School of Management, who explained how the information revolution is changing the organization of business and commerce.

- Sam B. Gardiner, lecturer on military history and strategy at the National Defense University, who speculated on how the information revolution might change the battlefield.

The workshop was videotaped so that both the discussions and the chalkboards could be preserved and reviewed for the preparation of a summary briefing and this report. The briefing was presented to the TRADOC Force XXI planners on January 4, 1994, and to the Commanding General of TRADOC on February 3, 1994. This report is the final documentation of the workshop, but it goes somewhat beyond both the workshop and its briefing by providing additional detail and background thought to be appropriate to the workshop subject of "Information Technologies and the Future of Land Warfare."

The report is composed of five chapters following this introduction. The first two chapters develop the subjects addressed in the first three introductory briefings provided for the workshop participants:

Chapter Two, "The Nature of the Revolution," offers an overview of the spectacular growth in computing and communications. Chapter Three, "Societal Implications," looks at the ways in which the information revolution is changing global distributions of power and reshaping the modern corporation.

The last three chapters are devoted to subjects developed through the workshop discussions: Chapter Four, "Land Warfare Implications," discusses the impact of advances in the information technologies on the nature of future battlefields. Chapter Five, "Operational and Organizational Concepts," presents six operational and organizational concepts that the authors believe to be both significant and representative of the many ideas considered during the workshop. Chapter Six, "Afterthoughts," offers some general observations that probably lie beyond the charter of the workshop but were nevertheless stimulated by its discussions and are deemed worthy of the Army's consideration.

THE NATURE OF THE REVOLUTION

The information revolution and its consequences for America's future are among the most discussed topics in public policy circles today. The most important *technology* policy initiative put forth by the Clinton Administration is the National Information Infrastructure (NII) or "information superhighway" program, which envisions the use of telephone lines, cable systems, and high-speed data networks to create an integrated information net that can be accessed by most elements of U.S. society.[1] While the exact architecture of the NII has yet to be defined, the program represents a bold initiative by the government to facilitate the harnessing of computing, communications, and information-access technologies in a bid to enhance the competitiveness of the U.S. economy.

Quite apart from the NII, the information revolution is having a profound effect on most aspects of American life. It is changing employment patterns, export flows, and the composition of private-sector investment. It is also drastically altering American homes, workplaces, and leisure and entertainment habits. Most pertinently, at least from the standpoint of this report, it is changing the nature of the conflicts that Americans will have to fight in the future and the ways in which they will be fought.

The term "information revolution" is not an exaggeration of what is happening today in the field of information technology. The rapid growth of computing, communications, and information-access technologies over the past three to four decades, and the likelihood

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[1] See *Business Week*, "The Information Revolution," Special Issue, 1994, p. 32.

that these technologies will continue such growth patterns for at least two more decades, indeed constitute a revolution in human affairs. This revolution has already reshaped both civilian life and military operations, but expert opinion indicates that the most momentous transformations in both these sectors are yet to come.

This chapter, based in part upon the introductory briefings given to the workshop participants, provides a broad overview of the physical nature of the information revolution by sketching the most salient past and future trends in the technologies driving it. Three topics are taken up: The first is the nature and magnitude of the growth in information technologies over the past half-century. The second is the likely growth for the foreseeable future. The third is a brief summary of the emerging technologies viewed as most promising by information scientists.

HISTORICAL TRENDS

Although there were some important developments in the information technologies before World War II, the foundation for today's information revolution came in 1947 with the invention of the transistor by J. Bardeen, W. H. Brattain, and W. Shockley. The transistor paved the way for solid-state integrated circuits and thence for modern electronic devices and telecommunications. Eleven years after the transistor's invention, the Bell Laboratories were able to produce the first fully transistorized digital computer. In the 1960s, transistor technology was married with space technology as the first active communications satellites were launched. The threshold to the current phase of the information revolution was crossed with large-scale integrated circuitry in the form of the microprocessor at Intel in 1971, just one year after the development of the dynamic random access memory (DRAM) chip.[2] Many secondary measures of the information revolution—such as the sudden rise in the production of information-related devices—can be traced to the mass production and availability of inexpensive microchips in the mid-1970s.

In this brief passage from electromechanical relays and vacuum tubes as switching devices for communications and computers to the

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[2]Ibid., p. 60.

microchip, four developments stand out as technical drivers of the information revolution: integrated circuits, computational power and cost, software, and fiber optics.

Integrated Circuits

The development of integrated circuits on silicon substrates or chips has probably been the single most important factor in the information revolution so far.[3] The primary measure of progress in the field of integrated circuits (ICs) is how many components (or transistors) can be fitted onto a single silicon chip. Figure 2 shows the exponential increase in the number of transistors that could be placed on a single chip between 1970 and the early 1990s for both memory and microprocessor chips. Extrapolating from the past two decades suggests that chips with about 100 million transistors should be available by the turn of the century.

The extrapolations seem to be supported by the most recent chip developments: The Intel 486™ chip introduced in 1989 had 1.2 million transistors; the Pentium™ chip introduced in 1993 had 3.1 million. Intel's P6™ microprocessor, just being introduced at the time of this report, has 5.6 million transistors in its central processing unit and 15.5 million in its associated memory cache.[4] Both of these numbers for memory and microprocessors fall nicely on the log-linear extrapolations of Figure 2.

Yet another metric for the density of components on silicon chips is the decrease in the width of the lines being drawn on the silicon substrate—such lines being the basis for solid-state devices and their connections. Here too, progress has been dramatic: In 1971, at the time of the microprocessor's introduction, engineers were able to lay

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[3]The United States is currently a net importer of semiconductors. In 1992, it had a semiconductor trade deficit of $3.8 billion. The largest sources of semiconductor imports are the East Asian newly industrialized nations (NICs) and Japan. The largest markets for U.S. exports are the East Asian NICs, Canada, and Mexico. The North American semiconductor market is the largest in the world, with sales of $27.77 billion expected in 1994. This represents 32.8 percent of the world total. All the above data are from U.S. Department of Commerce, *U.S. Industrial Outlook 1994*, Washington, D.C.: U.S. Government Printing Office, January 1994, pp. 15–16.

[4]Tom R. Halfhill, "Intel's P6," *BYTE*, Vol. 20, No. 4, April 1995, pp. 42–58.
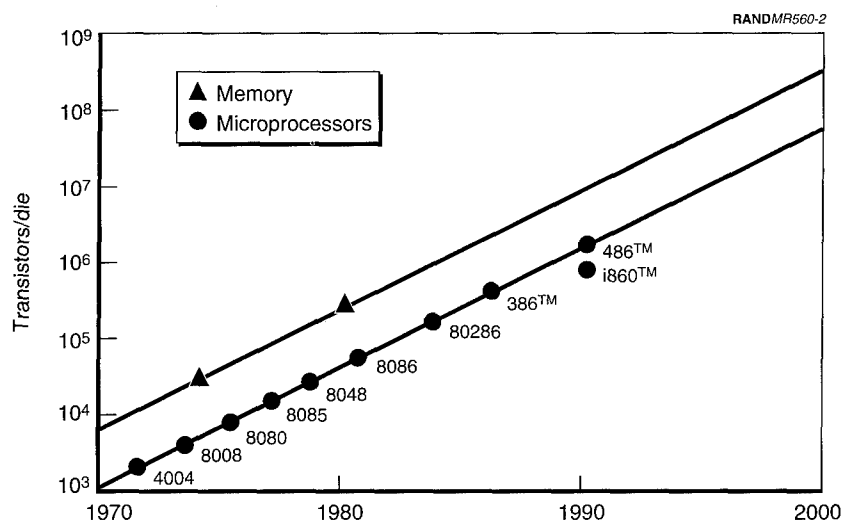
SOURCE: John L. Petersen, *The Road to 2015: Profiles of the Future,*
Corte Madera, CA: Waite Group Press, 1994, p. 30.
Data source: Regis-McKenna Company.

Figure 2—Transistors per Chip

down lines 6.5 microns wide on a silicon chip. By 1993, lines as nar-
row as one-half micron wide were being drawn.[5] Obviously, the de-
crease in line width makes it possible to place more transistors or
other solid-state devices on a given chip. Researchers at IBM have
recently claimed the world's smallest transistor—an experimental
metal-oxide semiconductor field-effect device—with dimensions
measured in terms of one-thousandth of a micron.[6]

The implications of the development and mass production of inte-
grated circuits have been profound. As the number of components
per chip has risen, so too have the speed and versatility of integrated

[5]See John S. Mayo, "The Evolution of Information Technologies," in Bruce R. Guile
(ed.), *Information Technologies and Social Transformation,* Washington, D.C.: Na-
tional Academy Press, 1985, p. 12, and *Business Week,* "The Information Revolution,"
p. 60.

[6]John L. Petersen, *The Road to 2015: Profiles of the Future,* Corte Madera, CA: Waite
Group Press, 1994, p. 29.

circuits; but the cost of digital systems has also dropped dramatically, facilitating the spread of computers and digital devices throughout the workplace into new roles, such as office automation. Business operations that depended upon bulky mainframe computers in the 1970s could, by the mid-1980s, be accomplished instead through flexible networks of micro- and minicomputers. Significantly for the future, IC technology is not expected to push up against its physical limits for some time yet. Optical integrated circuits, possibly 1,000 times faster than silicon ICs, have been projected to appear as soon as the turn of the century.[7]

Computing Power and Cost

As integrated circuits become faster and more dense, computing power (typically measured in the number of operations or instructions executed per second) increases and costs decrease, making computing increasingly accessible. Figure 3 illustrates this accelerating trend graphically in terms of how many bits per second a 1987 dollar could buy across the 20th century. During the age of mechanical and electromechanical computers—from 1900 to the 1940s—the amount of computing power that could be purchased for a constant dollar was increasing sevenfold every decade. During the age of electronic computers—from the 1940s to the 1970s—this rate had jumped to a sixteenfold increase every decade. Now the rate appears to be on an even higher slope, perhaps as high as a 4,000-fold increase in a decade. Even if this projection is optimistic—if we are witnessing a familiar "S" curve growth pattern near its maximum rate of change[8]—it would seem safe to suggest that computer power per unit cost is doubling at least every two years and should continue to do so into the next century.

Perhaps the most important point of this figure is that the phenomenal growth of computer power/cost associated with the information revolution is not a phenomenon associated with the recent technology of the 1980s and 1990s. Rather, it is rooted in a remarkably steady 40-year trend in electronic computing that began to make a

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[7]Ibid., p. 30.

[8]See Theodore Modis, *Predictions,* New York: Simon and Schuster, 1992, for historical "S" curve patterns in the evolution of technologies.
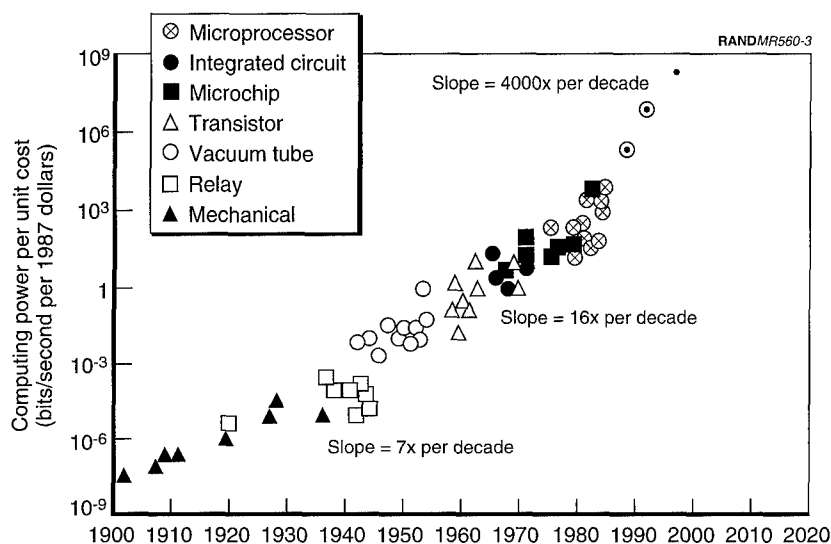
SOURCE: John L. Petersen, *The Road to 2015: Profiles of the Future,*
Corte Madera, CA: Waite Group Press, 1994, p. 31.
Data source: ARPA.

Figure 3—Computing Power per Unit Cost

widespread difference only in the mid-1970s, when computing
power/cost for personal computers crossed the threshold of about
100 bits/second/dollar. At that point, personal computers became
practical in terms of both their capability and cost. Whereas very few
people in 1950–1970 had the opportunity to see computing power
influence their lives, many millions can now see how the growth of
computing power and decreasing computer cost have had an im-
pact, as microcomputers and personal workstations proliferate in
both the office and the home.[9]

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[9]See the following selections from Tom Forester (ed.), *The Information Technology
Revolution,* Cambridge, MA: MIT Press, 1985: Sherry Turkle, "The Psychology of
Personal Computers," pp. 182–201; Jack Nilles, "Teleworking from Home," pp. 202–
208; Seymour Papert, "Computers for Children," pp. 229–241; Vincent E. Giuliano,
"The Mechanization of Office Work," pp. 298–311; and A. Richard Immel, "The
Automated Office: Myth Versus Reality," pp. 312–321.

Figure 4 illustrates how micro- and minicomputer processing power—expressed in millions of instructions per second (MIPS)—has expanded since the introduction of the Intel 8086 microprocessor in 1978. In six generations of microprocessors, performance has increased by over 750 times in 17 years—a growth rate of nearly 50 percent per year. And these extraordinary improvements do not reflect the even greater increases in computational capabilities now becoming available through the use of complexes of single-chip computers in new types of architectures (e.g., parallel processing) and networks (e.g., the emulation of neural networks).

Software

As impressive as the growth in computing capacity may be, it is not where most of the excitement of the information revolution is to be found. The hardware devices of the information revolution—computers, facsimile machines, video and audio recorders and players, copiers, satellites, etc.—have become the familiar and expected

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Since 1978, Intel's x86 processors have steadily increased in performance. Although Dhrystone MIPS are no longer considered a good measure of CPU performance, they are the only benchmarks that span all six x86 generations.

Dhrystone MIPS

8086	286	386	486	Pentium	P6
0.33	1.2	5	20	112	250+
1978	1982	1985	1989	1993	1995
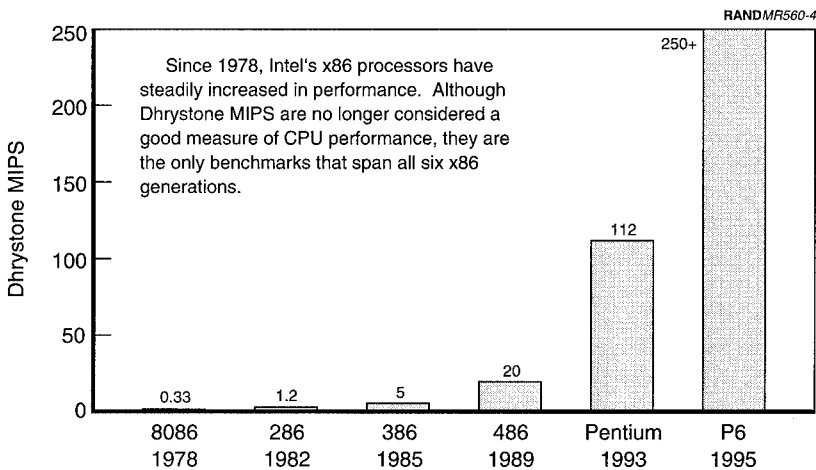
SOURCE: Based on an illustration in Tom R. Halfhill, "Intel's P6," *BYTE*, Vol. 20, No. 4, April 1995, p. 48. Copyright © by The McGraw-Hill Companies, Inc. Used by permission.

Figure 4—Trends in Micro- and Minicomputer Processing Power

background for new ways to access, exploit, manage, move, display, and store information. For the most part, the hardware devices are not new in their principles—most are more than 40 years old—they have only become more widely available and more capable because of the microchip. The truly revolutionary aspect of the information revolution—the transforming development—is to be found in the rapidly burgeoning software industry and its products.[10]

Software, not hardware, has been recognized for some time as the bottleneck of the information revolution. The production of software in the early decades of electronic computing was limited because of the kind of software required—systems-control software, as opposed to applications software—and because of the programming demands—applications require thousands and even millions of lines of programming code. The systems-control software made the machines work efficiently *internally*, but it did little to make the machines more accessible to nonprogrammers; the applications software required to make the machines accessible could (and did) consume large numbers of expensive programmers.

Now, however, the software logjam is beginning to break. More of the needed systems-control software is in place, more programmers are available for the development of applications software, and better tools—such as object-oriented programming and genetic algorithms—are becoming available to aid programmers and to improve their products. Software, as opposed to hardware production, is proving to be the big and profitable business of the information revolution. It is perhaps worth noting that the wealthiest individual in the United States is a software baron, a mirror of our times, just as the industrial and land barons flourished when industry or land dominated the development of the U.S. economy in earlier times.

Fiber Optics

Glass fibers have become the natural communications complement to the microchip. As electronic circuits and components—for com-

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[10]Cursory examination of any computer catalog or store for retail sales to consumers will quickly reveal that most of the goods for sale are in the category of software, not hardware.

puters and communications—were transferred to silicon, then integrated and miniaturized, switching speeds and frequencies rose faster than the capacities of wire or radio links. Glass fibers carrying pulses of light rather than electrons offer the ideal medium for high-bandwidth transmissions over long distances. Indeed, fiber optic transmission lines have become effective competitors to satellite communications, despite the obvious global access advantages of satellites, mainly because of the enormous bandwidth of light pulses in glass fibers, but also because of their shorter, more direct links.[11]

Three developments in fiber optics technology have been responsible for its rapid exploitation by the communications industry:[12]

- Producing high-purity and high-strength glass fibers,

- Optimizing the mode of light wave propagation in fibers, and

- Determining and exploiting the wavelengths (or frequencies) that minimize fiber transmission losses.

These developments have led to ever-increasing communications capacities per fiber and increasing distances between signal amplifiers. Figure 5 shows these trends in terms of the product of capacity (gigabits per second) and distance (kilometers). Over the last two decades, this capacity-distance product has been following a trend line that was doubling each year—by stair-stepping on new technologies for fibers, detectors, and amplifiers.

Although fiber optics have provided the largest surge in high-quality, long-distance communications capabilities, improvements in radio transmissions are coming by exploiting extremely high frequencies.

FUTURE TRENDS

Almost all the trends just described in computation and communications capacities should continue for at least the next two decades.

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[11]Many communications satellites are in stationary orbits above the Earth, making the links between two ground stations a minimum of about 44,000 miles and introducing a noticeable delay in two-way voice transmissions. A fiber optic link between those same two stations is significantly shorter and offers a much greater bandwidth.

[12]Mayo, "The Evolution of Information Technologies," p. 15.

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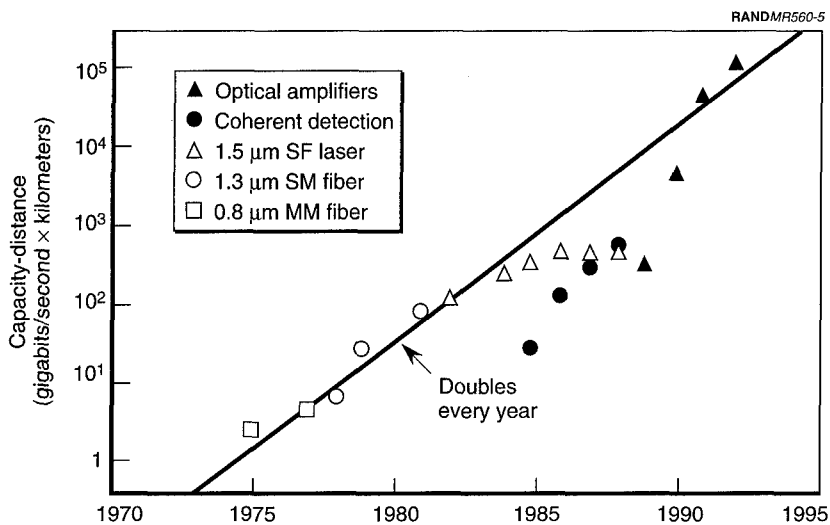
SOURCE: W. Press et al., *JASON Global Grid Study*, briefing JSR-92-100, July 1992.

Figure 5—Trends in Fiber Optics

Where physical limits loom to block these trends, a look into the laboratories suggests that new media and processes will be opening the way to even higher limits or potentials. Thus there should be no significant slowdown in the growth of the information technologies for the foreseeable future. Indeed, it now seems likely that the capacities for computing and communications may not slow until they begin to saturate their markets, perhaps sometime toward the middle of the 21st century.[13]

A portrait of the future can be painted by projections of computing power, communications backbone capacity, and international connectivity. Figure 6 is an extension of Figure 3. It projects growth rates in computing power between now and the year 2030, suggest-

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[13]This would follow the patterns observed by Modis in *Predictions,* for the evolution of prior transport and communications developments.
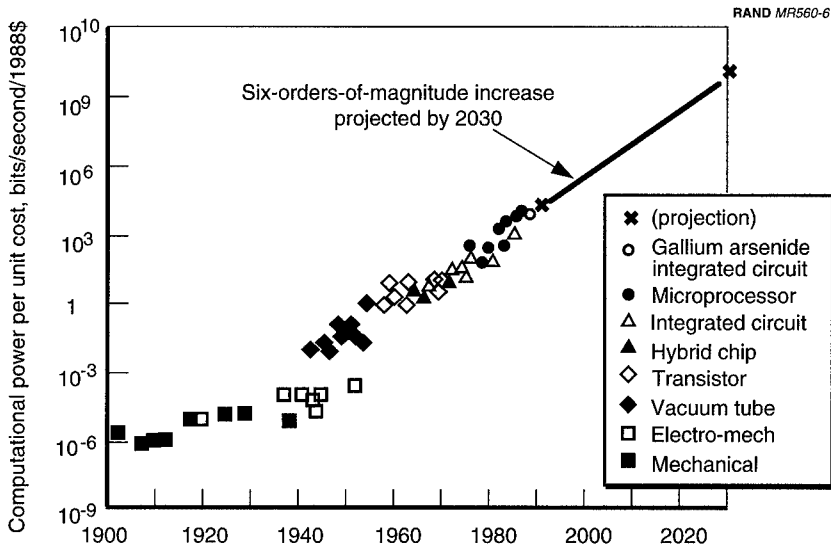
SOURCE: Hans Moravec, *Mind Children: The Future of Robot and Human Intelligence*, Cambridge, MA: Harvard University Press, 1988.

Figure 6—Projecting Computer Power/Cost to 2030

ing that the world will witness a six-orders-of-magnitude increase in computing power over 40 years. The introduction of the gallium arsenide integrated circuit is expected to be an important path into this projected future. Six orders of magnitude is equivalent to the growth in computing experienced since the very first electronic computers of the 1950s. For a more vivid comparison: six orders of magnitude worth of processing power is greater than the difference between the capacity of a bee's brain and that of a human being.

The trends in communications capacities reveal a remarkably similar picture, as shown in Figure 7. The rates of change for both computing power and communications capacity are following similar slopes—about 40 percent per year, or doubling every two years—because the speed of switching is a common factor to the growth of both. Rapid change is commonplace today, but the rate and duration of change in computing power and communications capacity
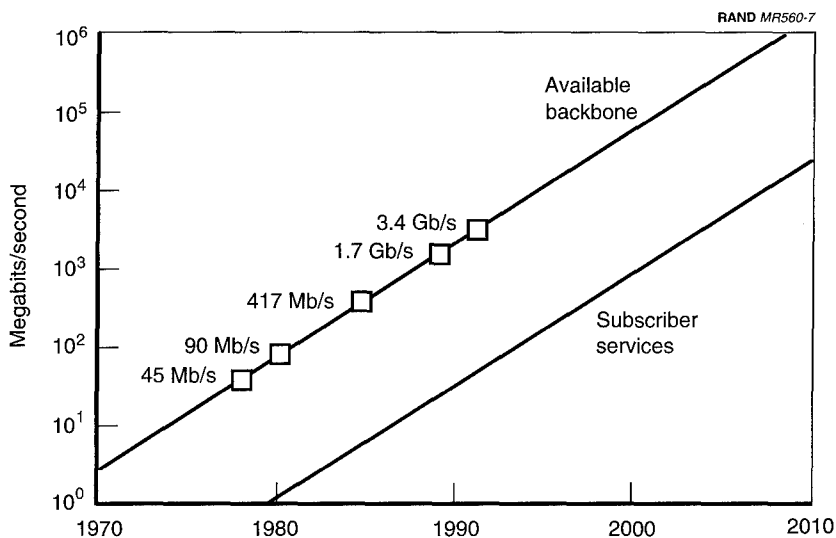
Figure 7—Trends in Communications Capacities

may be without equals in other human activities. For example, the widely apprehended changes in human population, depredations of the environment, or the AIDS pandemic do not match the steady rates of change in computing and communications throughout the last half of the 20th century. Indeed, if one asked what on earth is changing most rapidly—now and into the foreseeable future—it would be computing and communications.

The "available backbone" of Figure 7 refers to the capacity of the communication trunks, which typically carry about 100 times more traffic than any single subscriber is likely to demand for service. Thus, the projected trends indicate that the available communications backbone or "supply" provided by the most advanced technology will continue to grow at an extraordinary rate and that the limiting factor will be the "demand"—the ability of users to absorb what is offered.

The future should also see a continuation of the extraordinary increases in international connectivity via global computer-communications networks. Figure 8 shows four levels of international con-

nectivity—Internet, Bitnet, electronic mail (e-mail) service, and none—available by country.[14] Most of the world now has access to the Internet. The obvious "holes" are in Africa and the Middle East, where the connectivity may be limited in capability or nonexistent.

The explosive growth of subscribers to the Internet is chronicled in Figure 9, which shows the three phases of its evolution—first as the experimental ARPANet, then during a transition to commercial services, and then to a global network in the 1990s. Over the span of 30 years since its inception, the network has an average growth rate of over 70 percent per year. The volatility of growth is illustrated by the report that the subscribers on the Internet doubled during a six-month period in 1993.[15] If that exceptional rate were to continue through the end of the decade, the current access of millions would become billions. That growth rate will necessarily subside in the 21st century, for the numbers of subscribers would quickly exceed the world's population.

The political implications of this increasing connectivity are significant. It is now feasible for special interest groups to organize, plan, and coordinate activities from multiple locations around the world. Transnational "grass roots" movements can now develop and operate with an ease unimaginable only a few years ago. Unfortunately, this connectivity is also available to transnational terrorist organizations and crime syndicates. One consequence will be the creation of "distributed" threats and conflicts that may diffuse across national boundaries and originate in special interests independent of any national government.

OTHER TRENDS AND CONSIDERATIONS

In addition to these principal trends driving the information revolution, there are some others worth mentioning here. Overall, computing and communications devices are becoming lighter and smaller,

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[14]The latest edition of this graphic is available from the Internet Society, accessible on the Internet at the society's home page, located at http://www.isoc.org/.

[15]Petersen, in *The Road to 2015*, p. 37, asserts that the net "was growing at the rate of over 25 percent per *month*. At that rate (which of course cannot continue), every person in the world would be connected by 1997." Emphasis in the original.
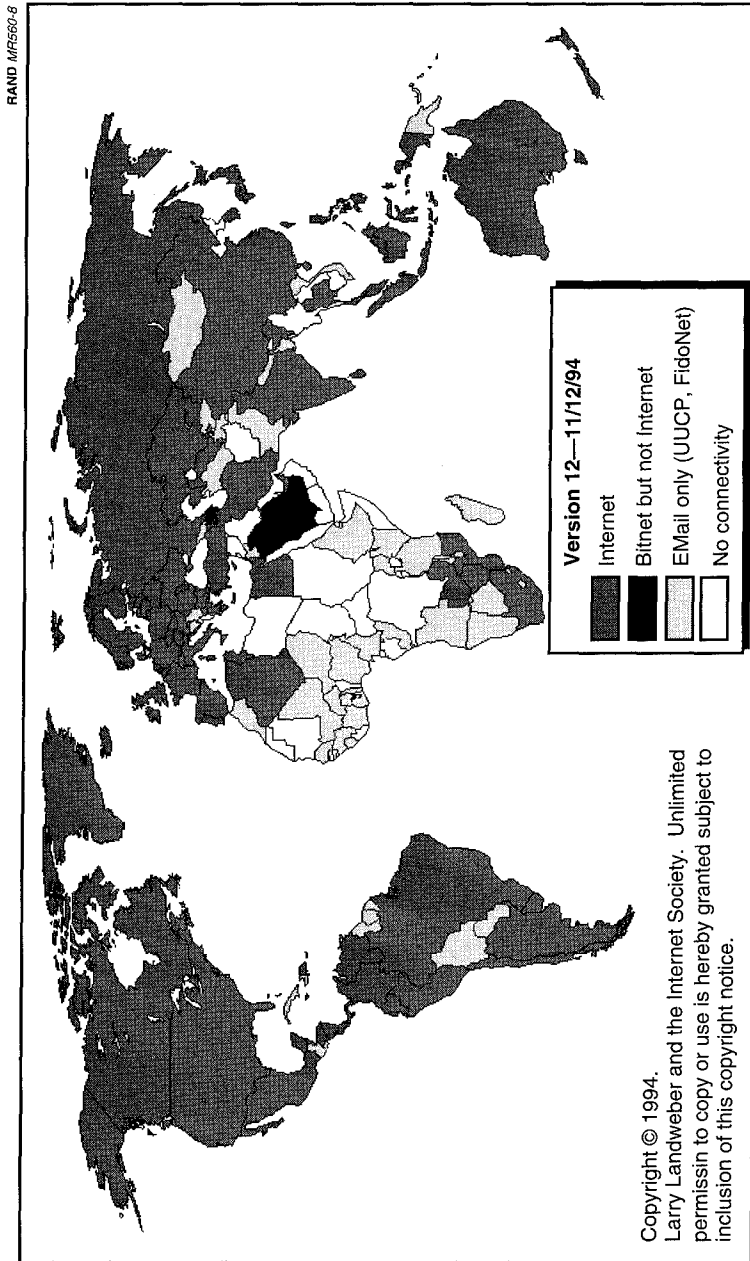
Figure 8—International Connectivity on Networks

RAND*MR560-9*

Figure 9—Evolution of the Internet
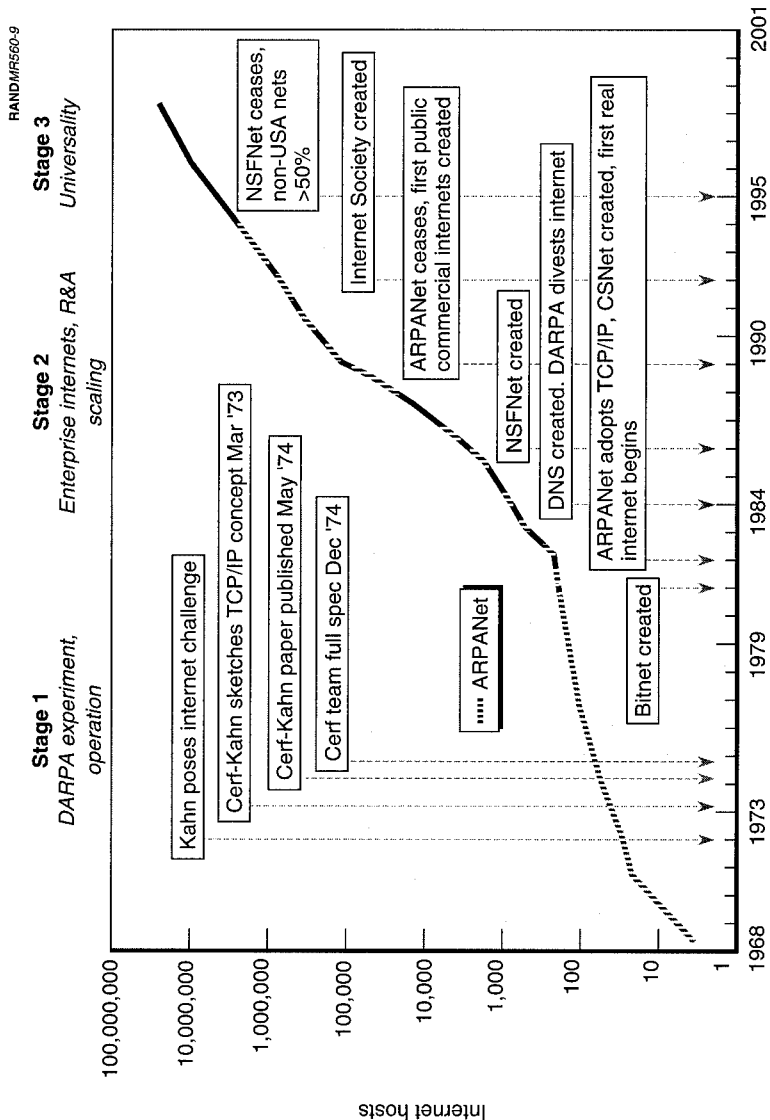
SOURCE: A.M. Rutkowski and Internet Society, 1994. Used by permission.

and they are consuming less power. This is making them more practical for use in mobile operations, both commercial and military.

In the commercial world, design and development cycles for new information technology products are noticeably shortening—with new devices going from concept to the store shelf in months—in order to saturate markets before imitations or competing devices can be produced in quantity. This trend stands in contrast to special-purpose military information systems for which—because of greater demands for reliability, durability, performance, and documentation—development cycles are destined to be longer than those of their nearest commercial counterparts. As a consequence, military information devices can end up being further behind the state of the art, more expensive, and therefore available in lesser quantities than those of their commercial equivalents. The expedient purchase of commercial hand-held Global Positioning System navigators during Operation Desert Shield is a celebrated example of the military turning to *commercial* products to maximize its exploitation of information from a *military* satellite system. In the future we should expect to see similar examples with portable computers and communications devices. More importantly, this trend suggests that potential enemies almost anywhere in the world may be able to resort to commercial information devices and thereby gain competitive or even superior capabilities.

Another important trend is that the computing and communications market, like many others, is now a global market. With enough money, virtually any group can obtain state-of-the-art computing and communications technology—if not from one nation or supplier, then from many others. One implication of the emergence of the global market for computing and communications is that the U.S. military's comparative advantage over future opponents is less likely to come from superior hardware than it is from more advanced software and operational and organizational concepts.

The information revolution will most likely continue at its current rate for at least twenty more years. During that period, the pace of developments for advanced societies will be increasingly set by the demand side of the equation, as opposed to the past dominance of the supply side. That is to say, the ability to design new concepts for

uses and users to exploit the available technology will be more of a barrier than the growth of the enabling technologies themselves.

It is quite possible that new breakthroughs could accelerate the information revolution beyond the trends projected above. One possibility is emerging from a field within the computer sciences commonly referred to as "artificial life." Some researchers believe that programming might be revolutionized through the use of "genetic algorithms" that can, like genes in an organism, be selectively "bred" to combine superior software elements to create new and innovative types of programs automatically and rapidly.[16] In the field of communications, some see similar promise in the coming of a new switching technology called Asynchronous Transfer Mode (ATM), which divides information into 53-byte packages, codes them, and sends them out at very high speeds—up to 20 gigabits per second.[17]

From the technology trends alone—even before we take up their implications for political, economic, social, and military enterprises—it is apparent that the information revolution is not misnamed: The changes are enormous in scale, breadth, and duration. They are certain to introduce profound structural changes in almost all human endeavors. And they will just as certainly remind us of Jacob Bronowski's warning about the nature—indeed the very definition—of revolutions:[18]

> From its earliest beginnings, when it was still dependent on water power, the Industrial Revolution was terribly cruel to those whose lives and livelihood it overturned. Revolutions are—it is in their nature, because by definition revolutions move too fast for those whom they strike.

Like all revolutions, the information revolution will produce excesses and victims. During its ascendant phase, it has been trumpeted by its heralds and condemned by its skeptics. After its peak and assimilation in the first quarter of the 21st century, it will disappoint some

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[16]*Business Week,* "The Information Revolution," pp. 64, 68.

[17]Ibid, pp. 72–73.

[18]Jacob Bronowski, *The Ascent of Man,* Boston: Little, Brown and Company, 1973, p. 286.

and be blamed for disasters.[19] But the enthusiasts and detractors will neither make nor break the flood of changes that are now transforming the world before our eyes. As was true in the Industrial Revolution or the Renaissance, the quality of the changes may be relative or subjective; but the magnitude and scope of change will be undeniable.

The pace of change will vary throughout the world and by groups. It is evident from Figure 8 that the connectivity of the worldwide network is much less in Africa and the Middle East than in North America and Europe. Some groups, for cultural or religious reasons, may have a greater reluctance than others to use modern computing and communications. Some groups may find themselves economically unable to acquire the latest electronic devices and software. So the information revolution may be an uneven phenomenon across the globe or across the country. And in that unevenness may lie additional stresses upon societies—whether they are "surfing on the net" or are left behind, by choice or not.

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[19]For phenomena to be found on the leading and trailing edges of revolutions, see Carl H. Builder, *Patterns in American Intellectual Frontiers,* Santa Monica, CA: RAND, N-2917-A, 1990, particularly pp. 20–23.

SOCIETAL IMPLICATIONS

The societal implications of the information revolution are both pervasive and profound. Prior revolutions—industrial, political, and social—may justly claim the same, but none before have conveyed power so widely or quickly downward to individuals, not just to a new set of elites. Political revolutions have sometimes diffused power more widely—as in the American Revolution—but most often they have transferred power from one elite to another. The revolutionary changes introduced through gunpowder diffused power from the castled and armored knight to a larger cadre of cannoneers and musketeers, but the transfer of power was from one very small elite to a somewhat larger elite. The information revolution is remarkable in part because it is diffusing the power of almost unlimited information to any and all who seek it. Not all may seek or elect to exploit the emerging abundance of information, but it is there for the taking, and the power it conveys depends only upon the creativity, imagination, and boldness of the individual. Never before in human history have so many had such easy access to so much potential power for so many diverse purposes.

This chapter sketches some of the major societal implications of the information revolution—changes in geopolitics and commerce that are largely due to the development of the information technologies. Not all of these implications are certain or irreversible, since they have not yet played out, and not all can be laid entirely at the doorstep of the revolution; but most observers do foresee major changes in social structures, commerce, and the international system.

The union of computers and telecommunications is making vast amounts of information available to large numbers of people who simply did not have such access even a decade ago. Access to overflowing information storerooms by groups, peoples, and organizations around the globe is facilitated by four characteristics of information that set it apart from physical commodities:[1]

- Information is not resource-hungry; it can often be exploited to conserve the use of physical resources.

- Information is easily transportable; it moves around the world on the wings of energy too small to be sensed without instruments.

- Information is diffusive; it leaks like a universal solvent despite great and continuing efforts to contain or restrict its spread.

- Information is shareable wealth; it seldom costs and often profits an individual to share information with one or many others.

In comparison to most industrial processes and their products, the dissemination of information requires negligible energy or other physical resources. Modern telecommunications make the transport of information a trivial matter—as we can see daily in the seamless operation of global equity and currency markets. Information, by human nature and by its own, tends to "leak" more readily than physical commodities. Monopolizing a physical resource is easier than monopolizing even a niche in the global information market; and as physical commodities find global markets—such as oil—the possession of physical resources counts for less and market information counts for more.[2]

The diffusion of power downward to individuals through the rapid spread of information on a worldwide basis is having three first-order effects. It is

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[1]Harlan Cleveland, "The Twilight of Hierarchy: Speculations on the Global Information Society," in Guile (ed.), *Information Technologies and Social Transformation*, pp. 56–59.

[2]See Peter Schwartz, *The Art of the Long View*, New York: Doubleday/Currency, 1991, pp. 47–60, for his story of the anticipation of a global oil market by Royal Dutch Shell. Shell realized, before the event, that dealing in a global oil market through information could be more profitable than extracting the oil. When the global market emerged and eroded the power of OPEC, Shell was ready with its trading plans and arrangements.

- weakening traditional hierarchical structures,

- facilitating many types of transnational enterprises, and

- eroding some traditional prerogatives of national sovereignty.

Each of these first-order effects is developed further below.

A WEAKENING OF HIERARCHIES

Hierarchical organizations have been a salient characteristic of human civilization; they are the basis upon which most authority, power, and command and control have been exercised for millennia.[3] But the information revolution is weakening these structures through two different processes:

- The shift from relative poverty to abundance in information permits individuals to bypass hierarchies that have—deliberately or inadvertently—controlled or limited information.

- Alternative human organizational forms—based mainly on the network—have proved more effective and efficient for transacting information than hierarchies. In information-intensive enterprises, hierarchical organizations may not be competitive with networks.

An example of the first process, bypassing, is to be found in the breakdown of the nuclear family in the information era. Before the flood of information through television, children acquired most of their information through hierarchical structures in the family, church, and school. Their parents, clerics, and teachers could control what children saw, read, or heard. Television short-circuited those controls. If some parents were determined to control access to that attractive and compelling medium in their own homes, they could not control it in the homes of others.

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[3]The authors are indebted to RAND colleague David Ronfeldt for his insights into the relationships between different kinds of human organizations and the transactions at which they excel. The hierarchy has proven itself throughout human history to be the superior organizational form for the transaction of authority, power, and command and control. Tribes, markets, and networks excel at distinct kinds of transactions.

Businesses, particularly those at the cutting edge of the information-intensive enterprises—computing, entertainment, and brokering—found that their networked employees could and would bypass their hierarchical business organizational structures. The tools of the trade—networked computers or other information devices, like fax machines—enabled employees to jump over divisional and echeloned barriers to get the information they needed to do their jobs, without the paper trail so characteristic of bureaucratic hierarchies.

An example of the second process, competitiveness in information-intensive enterprises, is to be found in the computer industry itself. Self-networked teams have proved superior to hierarchical business structures in developing new software and hardware.[4] The Hollywood film industry and the Nashville music industry—both quintessential information enterprises—have always been organized more as networks than as hierarchies. But the assaults upon hierarchies—whether in the form of bypassing or competitiveness—are bound up with the nature of the information revolution, which is empowering individuals with uncontrolled and uncontrollable information and increasingly shifting the content of enterprises from physical to informational commodities.

During the industrial era,[5] commercial organizations learned to adopt the hierarchical structure of the military as the most efficient way to organize individuals and allocate resources to *control* their markets.[6] With economies built mainly on the conversion of physical resources such as coal, steel, and petroleum to physical products, commercial industries dealt constantly with scarcity, bulk, limited substitutability, high transportation costs, and the risks of hoarding. Hierarchical institutions, with clear lines of authority and stark distinctions between superior and subordinate, were better suited than

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[4]See, for example, Tracy Kidder, *The Soul of a New Machine,* Boston: Little, Brown, 1981.

[5]For the United States, the industrial era began in the foundries and machine shops of New England in the 1850s and lasted until the middle of the 20th century, when rampant industrialism was foreclosed by labor, tax, and antitrust laws. On the European continent, the industrial era came somewhat earlier and lasted longer.

[6]Bracken briefing to the workshop on December 7, 1993, and Michael Hammer and James Champy, *Reengineering the Corporation: A Manifesto for Business Revolution,* New York: Harper Business, 1993.

family or collegial relationships for ensuring economic growth and market equilibrium.[7] And since most labor during the industrial era was performed through repetitive operations—conducted according to rigid standard operating procedures—hierarchical organizations were both logical and efficient.[8] The hierarchy thus became the preferred form of organization not only for militaries, but also for businesses, civil service bureaucracies, political parties, and the media.

Today, as the wealth production in the most advanced economies is increasingly derived from information rather than physical resources, hierarchical business institutions are becoming relatively less competitive. In the United States in the year 2000, as much as 66 percent of the work force will be working in information-related areas.[9] Where they are organized according to hierarchical principles, they will find themselves and their companies less competitive than those adopting more network-like structures. Not only will hierarchically organized businesses find that their organizations no longer reflect their actual processes, they will find much of their structure to be a burden rather than an asset to productivity and competitiveness.

Throughout the developed world, many traditional hierarchies will be weakened as a result of the information revolution. Both the ability and the need to filter information before it reaches the individual are declining in most parts of the world. In addition to large corporate hierarchies, one can expect social institutions, the established media, and many parts of governments and militaries to be affected.[10] These other hierarchical institutions are not immune to the forces behind the information-driven changes now so evidently transforming commercial organizations.

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[7]See Alfred D. Chandler, Jr., and Herman Daems, *Managerial Hierarchies: Comparative Perspectives on the Rise of the Modern Industrial Enterprise,* Cambridge, MA: Harvard University Press, 1980, and Max Weber, *The Theory of Social and Economic Organization,* Talcott Parsons (ed.), A. M. Henderson and Talcott Parsons (trans.), New York: Oxford University Press, 1947.

[8]For an organization theory perspective on this issue, see James G. March and Herbert A. Simon, *Organizations,* New York: Wiley, 1958.

[9]Cleveland, "The Twilight of Hierarchy," p. 57.

[10]Ibid., pp. 55–79.

There are two structural reasons why power is shifting away from traditional hierarchies and toward individuals. First, the information processing and filtering roles performed by many levels within traditional hierarchies have become obsolete. The advent of the global media and networks has greatly reduced the value added by multiple layers of information processing between the individual and the source of information.[11] Individuals can now sort through reams of unprocessed information and make their own assessments and decisions about its worth. Hierarchies need no longer serve as the exclusive conduit of information to the individual.

Second is the changing nature of the work force in advanced economies. As shown in Figure 10, information workers have outnumbered manual workers in the U.S. economy since the mid-1970s—the threshold of the most recent phase of the information revolution. Information workers generally do not need the structure or control provided by traditional hierarchical organizations, since their jobs require them to innovate and adapt on a daily basis.[12] Indeed, they operate most efficiently when they are given the autonomy to attack problems with their own independent approaches. Traditional hierarchies were designed to manage manual workers who mostly followed standard operating procedures each and every day. As the proportion of these workers drops in most national economies, the power and presence of traditional hierarchies will decline.

More and more human transactions in the developed world will be centered on the efficient exchange of information and commodities, and those will rely more on networks and markets than on hierarchies. The preferred commercial organizations of the future are likely to be those with comparatively few management or "control" layers and in which production employees operate in autonomous

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[11]Hammer and Champy, *Reengineering the Corporation.* Also see Robert G. Eccles and Richard L. Nolan, "A Framework for the Design of the Emerging Global Organizational Structure," in Stephen P. Bradley et al. (eds.), *Globalization, Technology, and Competition: The Fusion of Computers and Telecommunications in the 1990s,* Boston: Harvard Business School Press, 1992.

[12]For a discussion of how computers are creating new organizational possibilities, see James D. Berkley and Nitin Nohria, "The Virtual Organization: Bureaucracy, Technology, and the Implosion of Control," Harvard Business School Working Paper 92-033, 1992.
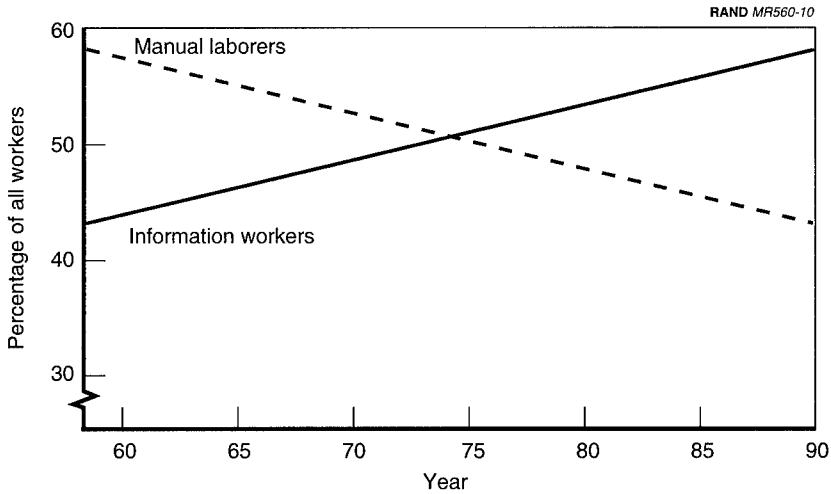
SOURCE: Theodore Modis, *Predictions*, New York: Simon & Schuster, 1992, p. 257.

**Figure 10—The Growing Proportion of Information Workers
in the U.S. Economy**

multidisciplinary teams.[13] More of their workers will need to inno-
vate on a daily basis. Managers in such organizations will manage
more through motivation, exhortation, and incentive rather than
solely through authority, mandates, and directives. The previous
statements notwithstanding, hierarchies will not disappear, because
social order will always require human transactions having to do
with authority, power, and command and control. Indeed, in most
fields of human endeavor, organizations will probably tend to evolve
into hierarchy/network hybrids in which certain key functions will
continue to be carried out in a hierarchical fashion. But in a break
from the past, the network "component" of these hybrids will be
significant.

The survival of hierarchical forms in many organizations will be due
to the fact that management and administration are about more than

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[13]See *Business Week,* "The Horizontal Corporation," December 20, 1993, pp. 76–81.

just information flow. They also have to do with ensuring that budgets are adhered to, employees follow certain standards of conduct, timelines are met, clients are kept apprised of the firm's activities, the capital stock is kept up to date, and accurate market analysis occurs. At least some of these tasks will need to be carried out in a hierarchical manner.

In general, it seems plausible to make the argument that functions that are time urgent and require reactive behavior will tend to be executed by groups that are relatively hierarchical in nature, while those that are less time urgent and allow for proactive behavior will be relatively more networked. For example, in armies one would expect the fire support function to stay hierarchical. This is because its command-and-control arrangement must be capable of responding rapidly to complicated and ever-changing lists of different classes of targets. On the other hand, echelon above division (EAD) combat service support (CSS) functions may well turn out to be organized more as networks, because there is somewhat less time urgency involved and commanders can be a bit more proactive. They can decide for themselves, for example, which units ought to have priority for depot repair service before a major offensive begins. These examples are only general illustrations, but they serve to demonstrate that hierarchies will never be entirely swept away.

One final cautionary note is in order. The shift from hierarchies to hybrids (and in some cases to pure networks) will occur at an uneven rate around the world because of cultural/developmental factors. In the nations of North America, Western Europe, and Northeast Asia, the change is taking place fairly rapidly. But in areas like the former Soviet Union and the Middle East/Persian Gulf, for example, the shift may take considerably longer (and in some countries it may never occur). It is difficult to imagine the Iranian, Iraqi, Russian, or Ukrainian militaries adopting networked forms of command and control in the near future.

FACILITATING TRANSNATIONAL ENTERPRISES

Some observers proclaim that the information revolution is creating a borderless world in which transnational activities will proceed

without friction.[14] Although this assessment is probably extreme, it is true that the development of information technologies is facilitating all sorts of transnational enterprises that heretofore have been limited by communications and information. Perhaps the starkest example is to be found in the growth in the size and power of the global foreign-exchange markets.

Before the 1970s, national central banks had substantial control over the prices of most major goods through their ability to manipulate interest rates and intervene in foreign currency markets. By the 1990s, however, the advanced state of computing and telecommunications technology had shifted some of the power from national central banks to the global currency market, which now trades over $1 trillion worth of currency per day.[15] The global currency market has become something of an independent actor on the world stage, sometimes forcing national governments to adjust their financial and monetary policies to prevent currency devaluation. Transnational networks of this magnitude could not exist before the world reached the current levels of reliable, near-instant, and almost limitless informational connectivity.

The feasibility of transnational activity allows large firms to disperse their operations across the globe. A maker of personal computers can, for example, now place its manufacturing plant in Europe, its finance division in the United States, and its marketing staff in the Far East. Such an arrangement would put it at no disadvantage compared to a competitor with all its operations in one city. Moreover, the dispersed enterprise can take advantage of talent, tax codes, and labor and physical resources that may vary from one part of the globe to another. This facility for global dispersal makes it easier for large corporations to avoid tariffs, unfavorable tax laws, and excessive regulation in certain countries by simply moving facilities to more appealing business environments. Strategic partnering between large

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[14]The best example of this school of thought is found in Kenichi Ohmae, *The Borderless World: Power and Strategy in the Interlinked Economy*, New York: Harper Business, 1990.

[15]Gregory J. Millman, *The Vandals' Crown: How Rebel Currency Traders Overthrew the World's Central Banks*, New York: Free Press, 1995, p. xi.

firms, especially in high-tech industries, is yet another consequence of the increasing ease of transnational activities.[16]

Unfortunately, the increased feasibility of transnational enterprises has a dark side as well. Transnational terrorism and organized crime are both facilitated by transnational communications networks and global markets for commodities.[17] New kinds of illicit associations are made possible—between traditional political guerrilla or terrorist groups on the one side and religious fundamentalist groups and organized crime syndicates on the other. For example, there is evidence of at least one of the ethnic factions in the Yugoslav civil war (the Muslims) becoming involved with drug-smuggling operations. Even more disturbing are the reports that the Italian and Russian Mafias may be organizing international networks to sell weapons-grade nuclear materials from the former Soviet Union to the highest bidder.[18]

The issues of possible future transnational terrorism and organized crime point up the fact that there is indeed a "downside" to the information revolution. Along with the numerous benefits it has spawned there are substantial risks. The large, interdependent computer networks that now control many important public infrastructures (air traffic control systems, financial market records, energy grids, telecommunications networks) could be vulnerable to sudden, catastrophic failures that would not have been possible one or two decades ago. Such failures need not even be the result of foul play. While the greatest threat of "info catastrophes" will probably come from the deliberate attacks of terrorists, one must not discount the possibility that natural disasters (such as a large earthquake) or simple human error could generate such events. In today's world, there is less time available to prevent the occurrence of such disasters once an initial mistake or disruption has damaged part of an interdependent network system.

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[16]Ohmae, *The Borderless World,* pp. 114–136.

[17]Graham H. Turbiville, Jr., "Operations Other Than War: Organized Crime Dimension," *Military Review,* January 1994, pp. 35–47.

[18]Seymour M. Hersh, "The Wild East," *The Atlantic Monthly,* June 1994, pp. 35–47.

In addition to the greater opportunities created for nefarious transnational enterprises and info catastrophes, there is also the more general concern about increasing social instability in some nations as a result of the information revolution. As power diffuses downward to individuals, it is possible that the weakening of traditional lines of authority and traditional hierarchies will create systemic pressures toward a period of global instability, one in which the different types of political actors in the international system grope their way toward an understanding of their place in the coming order.

ERODING NATIONAL SOVEREIGNTY

The traditional powers of the nation-state will suffer somewhat as a result of the information revolution. It is very likely that the nation-state will remain the most powerful actor in international events for the foreseeable future. However, nation-states will increasingly find their powers curtailed by the availability of information to those who reside both within and outside their borders; and those powers that remain will increasingly have to contend with nonstate actors who are acquiring power through the availability of information. Typically, hierarchical institutions become the victims of abundant information, while networks thrive on it. Since so many of the institutions of the nation-state are hierarchical and so many of the transnational organizations are networked, the net flow of power today tends to be out of the nation-state and into nonstate actors. Nation-states still have the advantages of the disproportionate concentration of power they built up over the past three centuries, as well as the inherent "neatness" of the international political order they can produce. Only tomorrow will reveal how far this shift in power will go, who the principal challengers to the nation-state will be, and, indeed, what may be the fate of the nation-state.

The areas in which national governments now have considerably less control than they did before the information revolution include

- Currencies and their valuation
- Markets and prices
- Businesses and their regulation

- Borders and the movements of people and commodities across them

- Information available to their publics

Currencies are now traded on global markets that can ignore what national governments may say about their value. The important commodity and product markets have gone global; they are no longer heavily subject to the policies of national governments or even cartels of national governments. Only where the sources of commodities are extremely limited in the world—such as the sources for diamonds—can national governments or cartels succeed in controlling prices. Even though much of the world's oil flows out of the Persian Gulf, there are enough other global sources at only marginally higher costs to keep Persian Gulf producers from exercising much control over prices. In a global market, other producers, standing idle, will come on line with small changes in prices.

Multinational corporations are free to move operations from one site to another, depending upon where they find favorable situations for their operations. Production plants are increasingly in excess, standing by for more favorable circumstances to reinstitute production. If Brazil, say, threatens to increase taxes on a certain production plant, the multinational corporation may remind the Brazilian government that the company has an idle plant in Spain where the production can be quickly transferred, at the invitation of the Spanish government offering favorable terms. In effect, the multinational corporations can play off national governments in seeking favorable conditions, with the governments bidding against each other in order to solve their unemployment problems and, hence, ensure their own political survival.

Borders have become porous: The Italians find themselves trying to keep the Albanians from coming across the Adriatic after watching "la dolce vita" on Italian television. The French look with concern across the Mediterranean to North Africa, where masses threaten to quietly invade their shores. The United States struggles to stem the tide of people who would leave their prospects in Mexico, Central America, and the Caribbean for the opportunities they perceive to the north. Information is driving these tides. More and more people

know what is going on in the world and how the rest of the world lives, and they have decided to vote with their feet.

The rise of international television news networks (such as CNN and BBC), fax machines, and global computer networks makes governments less able to control the dissemination of information, even though many have shown that they would if they could. Regimes that depended on information control to maintain their legitimacy are being swept away by the disenchantment of newly aware and mobilized polities. The very rapid, almost catalytic collapse of the Soviet bloc in 1989–1991 is testament to the inability of most totalitarian regimes to both retain their political control and become a part of the global economy.[19] Today, the information revolution permits "information control" regimes to survive only on the sidelines of the international system. Iraq, North Korea, and Cuba still maintain national policies of information control, but these states are relegated to the margins of the current world economy and may not outlive their current leaderships.

Nonstate actors both "above" and "below" the nation-state in geographical scope are now exercising influence on national governments. Many of the world's environmental and social problems have passed beyond the scope of the nation-state. The world increasingly looks to transnational or supranational organizations[20] to solve problems that have roots in the actions or failures of national governments. At the same time, the inability of most governments to control the dissemination of information means that subnational political groupings can use information "to exert power against their governments, societies, and institutions."[21] This power is reflected in the growing numbers of ethnic conflicts around the globe—some of which are attributed to the collapse of totalitarian regimes of the

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[19]Carl H. Builder and Steven C. Bankes, "Technology Propels European Political Change," *IEEE Technology and Society Magazine,* Vol. 11, No. 3, Fall 1992, pp. 10–17.

[20]As used here, a transnational organization is one that operates across and largely independent of nations; a supranational organization is one that derives its powers through and from a group of nations. By these definitions, Amnesty International is transnational, and the United Nations is supranational.

[21]Gladys D. Ganley, "Power to the People via Personal Electronic Media," *The Washington Quarterly,* Spring 1991.

Cold War,[22] which themselves were victims of the information revolution.

Although it is common to project the future enemies and threats to the nation-states as other nation-states, the future could well be one in which the principal threats to the established nation-states are subnational and transnational groups that seek nation-state status (or at least substantial autonomy) for themselves. This is certainly the pattern evident in most of the current conflicts around the world—in the persistent violence of Kurdistan, Kashmir, Chechnya, and Bosnia.

It is not yet clear whether the supranational forces tending toward a more orderly world or the subnational forces tending toward a more chaotic world will be favored in the first half of the 21st century. There is some evidence that the process of diffusing power favors the subnationals. The supranationals are acquiring power from the nation-states only to the degree it is granted by them. The reluctance of the nation-states to grant power to the supranationals is evident in the bumpy roads to the formation of the European Economic Union and the military capabilities of the United Nations. On the other hand, subnational groups tend not to wait for the granting of such powers: Quebec or the Kurds will not; they would seize power for themselves at the expense of the nation-state.

TRANSFORMATION OF COMMERCIAL ORGANIZATIONS

The business world is perhaps the most transparent laboratory of the information revolution. Driven by the imperatives of economic competitiveness rather than the preservation of political power, free from the paralysis of contending special interest groups, large corporations are reshaping themselves to take advantage of the opportunities presented by the growth in information technologies—even as those technologies threaten the power of hierarchical bureaucratic structures elsewhere.

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[22]William A. Stofft and Gary L. Guertner, *Ethnic Conflict: Implications for the Army of the Future*, Carlisle Barracks, PA: U.S. Army War College, March 14, 1994.

Despite the devotion of many articles in current business journals to organizational changes attending the information revolution, change in U.S. corporate structures is not new and did not suddenly start in the 1970s. For a century, from about 1870 to 1970, U.S. business underwent a major transformation, typically from the family-owned single plant serving and dominating a local market to the stockholder-owned complex of plants and divisions serving, shaping, and competing for national markets. The constant during this century of change was the dominant corporate objective of controlling the market, first local, and later national. If markets could be controlled—created, shaped, or dominated—profits would follow. The natural organizational structure for this objective of control, proven by the military, was the hierarchy.[23]

Throughout the century of change that preceded the information revolution, the hierarchical organization in U.S. business spread and deepened. As businesses and their markets grew in size and complexity, more specialized training and more detailed standard operating procedures (SOPs) were required for increasing levels of management. Hierarchical management structures became taller and required more SOPs, and corporations trained cadres of specialized professional managers. The result was an increasing number of middle managers who mostly controlled and processed the flows of information between production workers and senior executives. The earliest information technology, electronic data processing, became available in the 1950s and 1960s and was used mostly to expand the spans of control in the traditional corporate bureaucracies.

After the mid-1970s, most major U.S. corporations (as well as some foreign firms) began to view information technologies differently. The new business environment was largely defined or characterized by four developments:

- Global markets emerged that could not be controlled by a nationally oriented business. Increased international competition (especially from Japan) forced many large U.S. companies to look for innovations as a way of insuring their survival. The margin

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[23]Bracken briefing to the workshop on December 7, 1993.

for error in markets like automobiles and semiconductors shrank substantially as international competition increased.

- The evolving social environments in many of the advanced countries of the Northern Hemisphere, with their increased tolerance for less capable and dependable workers (evidenced in drug use, crime, and a decline in the quality of public education), required business leaders to reconsider the nature and dependability of their labor pool.

- The increased accessibility of information technology through the workstation, microcomputer, and office automation offered new opportunities for reorganizing business processes and their use of labor.

- As shown in Figure 11, the relative cost of labor began to rise in comparison to the cost of capital.

In response to these new realities of the 1980s, Western commercial organizations began to rethink their mode of operations more deeply than they had since the late 19th century. Large firms have become more flexible and less layered, and they rely on smaller but more sophisticated blue-collar work forces. Layers of middle management have been eliminated, making firms less vertical in nature. In many companies, process has been placed ahead of function in corporate values. The main organizational unit in a traditional corporation used to be functional departments, e.g., finance or marketing. Today, innovative firms are restructuring their organizations around process, i.e., combining all of the functions required to produce a single product—design, development, production, and marketing. The structure of these firms is centered on multidisciplinary (multifunctional) product teams that handle all aspects of a single product, from product conception to closeout. Such teams are apparently responding more rapidly to market changes than are traditional hierarchical and functional corporate structures.

Before the full flowering of the information revolution and the globalization of markets, most U.S. corporations saw diversification as a safety net for market uncertainties and changes as they sought to control their business environments. Healthy divisions in diversified firms could "carry" divisions with weak markets; divisions could provide crossover support to their siblings for needed expertise or

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Figure shows a line chart titled with the embedded text:

Ratio of total labor compensation costs per unit of output to the blended cost of debt and equity financing

Index: 1982 = 100

Y-axis values: 0, 100, 200, 300, 400, 500

X-axis values: 1980, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93
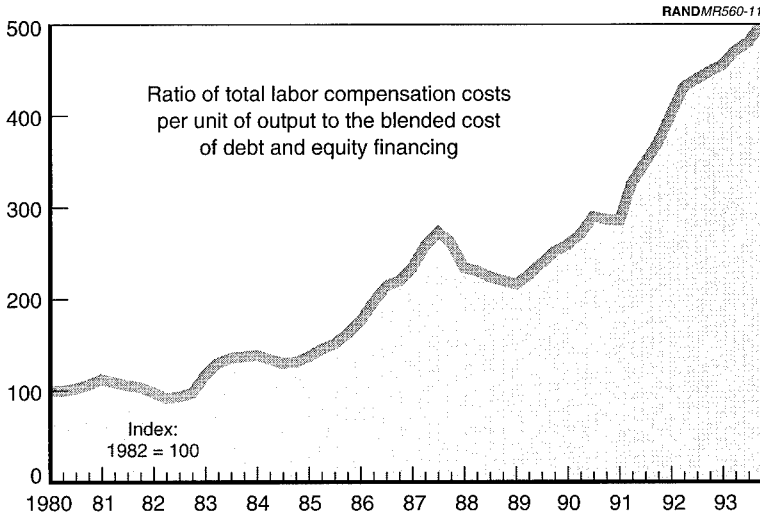
SOURCE: *Business Week*, "The Information Revolution 1994," May 18, 1994, p. 107. Data from Regional Financial Associates.

Figure 11—The Rising Cost of Labor

commodities. So long as the objective was controlling national markets under national laws, diversification was worth its costs in coordination and excess capacity.

But global markets intensified competition and removed the rules that permitted control of markets. The result is a return to focused business practices, including the concept of core competencies. The shortened design and product cycles made possible by computer-aided design and automated production make it imperative for firms to master a few key areas. Fierce competition means there is no time to diffuse energy and human capital by trying to absorb new businesses on a regular basis. Many contemporary business consultants now argue that the most important function of modern managers is to identify and cultivate a firm's core competencies.

The role of the business manager has also been transformed by the information revolution. Managers used to, almost exclusively, tell workers what to do and how to do it. Management by directive was the norm, and the directive was usually based on established stan-

dard operating procedures. But the proliferation of advanced information systems, the reduction in product cycles, and increased competition have made management by directive unsuitable in many situations in many industries. Now, as workers become fewer, more specialized, and more sophisticated, the manager's role has come to include the frequent use of facilitation instead of directive. It is now often the case that the manager's most important duty is to ensure that workers have the tools, resources, and autonomy to do their jobs properly. Managers still need to exercise their authority by directive for certain purposes, such as ensuring compliance with new regulations or guidelines, but this model of management is no longer applicable in all contexts.

With all of these changes in markets, the availability of information, and the roles of managers and workers, it is not surprising that new organizational forms have come into vogue. Much experimentation is evident. The "flattening" of hierarchical management structures is only a reactive response; the search for a replacement for the hierarchy—in theory and practice—is a hotly debated business issue. New organizational concepts have sprouted, with flamboyant names like the "pizza pie" (clusters of units like pepperoni on a pizza), "shooting stars" (new product units flying off from the parent to their own destinies), and "shamrock" (for the leaf-like arrangement of contributing elements).[24]

One of these new concepts, the shamrock organization, whatever its merits may be in practice, is worthy of further discussion here (as it was during the workshop) because it vividly illustrates some of the fundamental changes in business, commerce, and society described above. The shamrock organization, shown in Figure 12, derives its name from the arrangement of its three major components like the leaves of the shamrock.[25] The center leaf is the relatively small core of permanent professional employees who make the company what it is and will be. The right leaf is the contingent work force, who are temporary employees hired or contracted for production or other functions of the company, only as they may be needed. The left leaf

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[24]See *Business Week,* "The Horizontal Corporation."

[25]The description of the shamrock organization provided here is derived from the Bracken briefing to the workshop on December 7, 1993.

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Professional
core
employees

Contractors

Contingent
work force
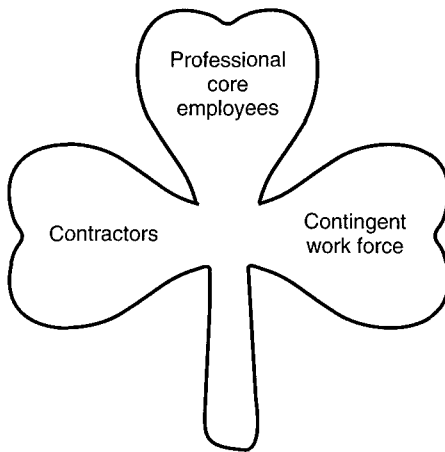
A divestiture of responsibilities for people?

Figure 12—The Shamrock Organization

is the contractor-suppliers, who have a longstanding, symbiotic, and intimate relationship with the company.

Today's information revolution has decreased the value of many types of employees to corporate leaders. Moreover, government regulations have increased the burdens of hiring, firing, and maintaining employees on the payroll. The shamrock organization seeks to create a leaner, more efficient corporation by removing many types of nonessential, unskilled, and seasonal jobs from the permanent payroll. The permanent workers—both blue- and white-collar employees—are those the company knows it will always want and will be able to employ productively, even as products and markets change.

Temporary workers become much more numerous as positions regarded as nonessential (e.g., routine maintenance or clerical work) or subject to fluctuation (production-related) are farmed out to "temps" who must look elsewhere for their benefits and job security. If these benefits and security are not provided by other firms that supply the temporary employees, then that burden may fall upon the govern-

ment. This arrangement also tends to cut the temporary employees off from access to career development and promotions within the company—the common path for many unskilled workers to the development of skills and to the achievement of middle class economic status. In this sense, the shamrock organization allows companies to shrug off the social burdens they had accepted before the information revolution and global markets—when they were controlling their national markets with the cooperation of national governments. This is a striking example of how globalization and information have broken a century-old bond between business and the state in U.S. commerce.

The wealth-generation activities of the corporation come to be performed by a small group of information managers and skilled production workers (the professional core). The contractors are those who enjoy a semipermanent relationship with the company in providing goods and services in ways that are most beneficial to the company's purposes—not necessarily at the lowest price. An example of the symbiotic relationship between company and contractors is provided by the supplier of batteries to a Japanese automobile manufacturer: The battery supplier may not supply batteries at the lowest price, but the supplier carries each battery on its own inventory costs until it is actually installed on a car on the production line—which means that batteries in the storage racks at the production plant are the property and inventory cost of the supplier. If production should halt, the inventory burden of the batteries is carried by the contractor-supplier.[26] Thus, the contractor shares in the production risks of the company and has every incentive to keep inventory costs to a minimum, while the company has an obligation to treat the contractor as a partner in the mutually beneficial sharing of information.

Although the shamrock organizational concept is only one of several ideas currently being advanced for the future of the corporation, its emphasis on reducing the permanent payroll of employees to a minimum skilled core in order to reduce fixed costs is not an

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[26]Another example of this practice is provided by the wily Henry Ford, who insisted that his battery supplier provide batteries in specifically dimensioned wooden crates. The supplier subsequently learned that Ford was knocking down the boxes and using the wood, without further cutting, as floorboards for his Model T automobiles.

anachronism. The information revolution has had the effect of enabling fewer workers to produce more and has also reduced the value of many manual-labor positions.[27] The political, economic, and social consequences of this clear trend for large sections of the U.S. labor force are likely to be enormous and mostly unhappy.

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[27]An example of the devaluing of labor by computers is provided by the use of hand-held computers by car rental firms for returning vehicles: The parking lot monitor needs only to key in the car's mileage and the contract number; the computer provides the rest of the information and prints out the billing receipt. This is a case where the computer degrades the skills required of the parking lot monitor to a few hours of instruction and eliminates the need for a counter check-in attendant.

LAND WARFARE IMPLICATIONS

Before turning to the principal workshop task—identifying new operational and organizational concepts for the U.S. Army evolving from the revolution in information technologies—the workshop participants spent some time discussing how the revolution might change the Army's "business": the changes in the nature of warfare, particularly land warfare, and in the roles of the Army and its client, the U.S. government, as they relate to conflicts. The observations produced by these discussions in the workshop were somewhat disparate in nature, but some overlapping themes were discernible:

- The context—the world and the American society—in which the Army will confront conflicts and warfare is likely to change as a result of the information revolution even more than the U.S. Army or the technology it brings to bear. The larger changes being wrought in the context and nature of warfare by the revolution in information technologies will require more than technological responses by the U.S. Army.

- To take advantage of the opportunities being afforded by the new age of information abundance, the Army will need to alter its organizational and operational modes of behavior. The information revolution is changing warfare most profoundly not through the introduction of new weapons but through the emergence of new modes of conflict.

- The opponents of the future will present challenges because the new geopolitical environment is fostering types of contingencies and opponents for which the U.S. Army may not be doctrinally prepared. Some of these types of contingencies may be similar

to those we have not handled well in the past (e.g., Vietnam-type insurgencies).

- The Army cannot afford to focus its doctrinal thought, over the long run, on the standard MRC scenarios for Korea and Southwest Asia that now serve as the basis for U.S. defense planning. While these standard scenarios may (or may not) be an appropriate benchmark for force planning over the next couple of years, the long-term tests that will be the most stressful for the U.S. Army will be those involving warfare under novel circumstances and against new types of actors—circumstances and actors that have been made possible by the information revolution.

These themes are developed in greater detail, separately, below.

MORE THAN APPLYING TECHNOLOGY

The advances in the information technologies are only a few of many variables influencing the future of war, and that influence may appear less on the battlefield than in the transformation of societies and why and how they become antagonists. Perhaps the more important variable to consider on the battlefield is not the use of the new technology, but the facilitation by technology of asymmetric doctrines and strategies for U.S. opponents.

Although information technology will be an increasingly important element in military science, it is only one of several working to shape the battlefields of the future, as shown in Figure 13.[1] For example, the increasing precision and range of modern weapons, when coupled with continuing improvements in sensors and information processing, will certainly be among the foremost factors considered by American military planners as they define the future battlefield and the weapons and doctrine they need. But those factors may not be the ones to dominate outcomes in future conflicts if the U.S. Army finds itself fighting mostly against enemies who pursue asymmetric objectives and employ asymmetric doctrines.

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[1]This argument is found in Sam Gardiner, "Planning for the Next Quarter Century: What in the World Is an Air Force to Do?" unpublished paper, March 1993.

- Information technologies are but one source of the many changes
  - We ignore the others at our peril
- Potential reactions to U.S. military capabilities
  - Parallel: improved PGMs (fight fire with fire)
  - Direct: better air defenses (fight fire with water)
  - Passive: dispersion (remove the fuel for the fire)
  - Asymmetrical: special operations (Smokey Bear)
- Asymmetries in objectives and doctrines may count for more than technological advantages
  - Most potent when combined with selective, opportunistic exploitations of technology

Figure 13—Battlefield Transformations

U.S. military planners will not see the true measure of an opponent by looking first or last at the opposing technological capabilities. This is a trap into which the U.S. military has fallen on several occasions in the past (the Vietnam War being only the most glaring example). More important than technological comparisons are potential asymmetries in doctrine and objectives. This may be especially true in the aftermath of Desert Storm, where all the world—enemies and allies alike—took careful note of how the United States used its military power. Most potential U.S. opponents around the world now realize that it would be futile to challenge the American military with regular forces on a conventional battlefield, and if they haven't already, they will almost certainly devise plans for matching their particular areas of strength against areas of perceived U.S. weakness—as they may have perceived it in Bosnia or Somalia.

Opponents who have unorthodox doctrines or unconventional objectives will be more difficult to deal with than adversaries who operate in a conventional Western military mindset. To cite an obvious

example, the United States faced more vexing problems in its military efforts to unseat General Aidid in Mogadishu than it did in crushing the Iraqi military during Desert Storm.[2] The Iraqi military was technologically far more sophisticated than Aidid's militia was. However, while the Iraqis followed orthodox Soviet military doctrine (which the U.S. Army understood very well), Aidid and his supporters did not seek battlefield victory or defense in the traditional sense. Instead, they aimed at

- embarrassing the United States and the United Nations politically through the international media,

- employing guerrilla tactics in a densely populated urban area and using unarmed crowds to shield their militia from attack by U.S. forces,

- exploiting the weaknesses of the opposing multilateral force that were created by widely varying capabilities and modes of operation, and

- acting more quickly than the cumbersome command structure of their opponents and using Somali civilian employees at UN and U.S. facilities as sources of intelligence.

Adversaries with asymmetric doctrines and objectives could be even more formidable in the future if they are able selectively to employ "niche" technologies to complement their operations.[3] Cellular telephones come to mind. There was some concern about their use in the Los Angeles riots of 1992 to coordinate looting operations. When cellular telephones exploit satellites rather than terrestrial antennas (e.g., as proposed by Motorola), they will become more difficult to counter and more widely available where there is no equivalent surface infrastructure (i.e., local ground antennas). Taken to the extreme, one could imagine a situation in which a subnational,

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[2]American efforts to hunt down and capture Aidid climaxed in the bloody Mogadishu battle involving the Army Rangers on October 3–4, 1993. A brief account of this engagement is presented in "Firefight From Hell," *Newsweek*, October 18, 1993, pp. 39–43.

[3]A "niche" technology is defined here as one for which the user need not develop a broad technology base in order to exploit an available, state-of-the-art technology on the battlefield. The effective use of the Stinger missile by Afghan rebels is an example.

network-organized opponent with lightweight, portable communications devices was able to "get inside" the decision-time cycle of U.S. Army forces in a certain engagement and respond to breaking events faster than the local U.S. commander could. Selected biological weapons, accurate theater ballistic missiles, and Global Positioning System (GPS) receivers are additional examples of the types of niche technologies that a cunning opponent could use as part of an asymmetric military response to U.S. operations.

As a way of energizing their thinking about asymmetrical responses to U.S. military capabilities, the workshop participants were invited to consider four fundamentally different responses by an opponent, as listed below.[4]

- **Parallel** reactions are those in which the opponent tries to obtain weapons comparable in kind and quality to those of the adversary. In a parallel counter to U.S. tactical fighter strength, for example, an opponent would try to procure state-of-the-art air superiority fighters armed with sophisticated air-to-air missiles. This is the type of response for which the U.S. military prepared itself in the Cold War; it is now one of the least worrisome because there are no adversaries on the horizon who could mount across-the-board "parallel" challenges to the U.S. military.

- **Direct** responses are those in which the opponent moves to acquire weapons that are intended to be the most effective and efficient counters to the adversary's strength, not necessarily in kind or quality. A direct counter to U.S. tactical fighter strength might be the procurement of a state-of-the-art surface-to-air missile (SAM) network to deny U.S. military forces the use of the air.

- **Passive** responses are those in which the opponents move to make their target set less vulnerable to the adversary's weapons. This might be done through dispersion, hardening, mobility, deception, and concealment. The passive option may be attractive to U.S. opponents in the future because of the demonstrated capabilities of precision-guided weapons in the Gulf War. Few

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[4]Sam Gardiner, "The Character of the Future Battlefield and the Role of Information," briefing delivered at RAND, Santa Monica, on December 7, 1993.

could fail to observe the stark difference between the U.S. capabilities for precisely striking buildings or bridges and those for finding and attacking mobile SCUD launchers.

- **Asymmetrical** responses are those in which the opponent moves to shift the foci of a conflict to areas of comparative advantage. Terrorist attacks or even nuclear strikes against several major U.S. air bases in the theater of operations are obvious examples of an asymmetric response. Here the enemy would use weapons or tactics to neutralize U.S. power without directly engaging that power on the terms for which it was designed.

SHEDDING MIDDLE LAYERS

Since militaries are in the "business" of transacting power, a hierarchical organizational scheme will almost certainly remain the dominant management structure in militaries everywhere, despite the information revolution. But this does not mean that military hierarchical structures are immune from being bypassed or becoming uncompetitive in their present form as the effects of the information revolution take hold. The high vertical hierarchies so characteristic of militaries may have to be abridged; in some activities or functions, hierarchies may have to tolerate networks in order to exploit or remain "competitive" in the information age.

The ever-increasing power of communications and information processing, when coupled with the battlefield computer networks, makes it feasible for very small units (say, battalion size and below) to communicate directly with theater headquarters. As in businesses with an abundance of information at all levels, there is now less value added and substantial time lost as certain types of information pass through middle echelons and standard operating procedures on their way from small front-line units to higher headquarters.[5] The implications are that, over the long term, middle levels of command

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[5]Air defense of the battlefield is an example of a function that has, for some time, been vulnerable to the time lost in passing information through successive command layers. The "uncompetitive" nature of the command arrangements for air defense has escaped rectification only because it has not been tested in battle and shown to be unworkable.

may shrink somewhat in size and functions, and smaller units may operate more freely and autonomously on the battlefield.

An extreme illustration of these possibilities is to be seen in the Swedish military's "cell concept" for deployment and employment of its forces for defense. Although the cell concept is only that—a proposed concept and not an implemented organization of Swedish forces—and although it is proposed for defensive operations only, the idea illustrates just how much modern communications and information systems could change military organizations. The concept is illustrated as an overlay on a map of Sweden in Figure 14.[6]

The Swedes are in the process of developing an experimental military doctrine around the cell concept. It presumes the use of small autonomous units, roughly of battalion size, equipped with multipurpose and air defense missiles and backed up by vertical/short

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Cell Structure

Packet radio

Output antenna

32 high-tech commandos

16 multitarget missiles

8 close ground-to-air missiles

4 long-range ground-to-air missiles

Dummy platoons

VSTOL Aircraft

6 to 8 multitarget missiles

2 to 4 air-to-air missiles
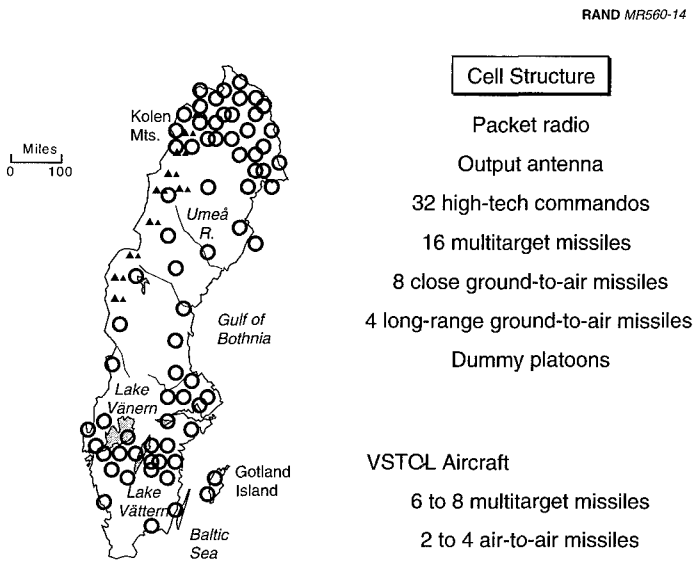
Figure 14—A Swedish Defense Concept

[6]This figure was presented in Sam Gardiner's briefing "The Character of the Future Battlefield and the Role of Information," December 7, 1993.

takeoff and landing (VSTOL) aircraft. Each cell is responsible for defending a fixed geographic area. These units would not fight in a coordinated linear fashion, but instead would use surprise, deception, and favorable terrain to engage an attacking enemy at a time and place of the defender's choosing. Information technology enables each cell to keep abreast of the direction of the theater campaign and to determine what it must do to positively influence that campaign. The concept would seem to be a direct military translation of several new commercial business practices cited in the previous chapter as consequences of the information revolution. The Swedes are able to contemplate such a concept because of (1) channelized terrain and (2) a potential opponent (Russia) having lots of heavy armor/mechanized forces with long supply trains that would be vulnerable to hit-and-run attacks by small, autonomous commando teams.

The applicability of the concept to U.S. military operations is problematical at best. The Swedish concept is designed for use by a state that plans to be on the defensive and has no hope of outright victory over a superior foe (in this case, Russia). The Swedish idea is well suited to a deterrence-through-punishment strategy with a force designed to inflict as much pain as possible upon the enemy before it is itself ultimately defeated. At most, the concept shows how far military organizations might be driven by technology and circumstances toward the structures and operating philosophies now being adopted by business organizations in response to the information revolution. The workshop participants referred often to the concept, not because of its merits for U.S. defense planning, but because it reflected a possible future for several of the world's armies.

WHO IS THE ENEMY?

It is not likely that the end of the Cold War and the rapid expansion of communications and computational capabilities are unrelated. The sudden collapse of the closed communist regimes may have been one of many consequences of the information revolution; those regimes simply could not compete with expanding Western economies and remain closed. And if they did not remain closed—and doing so was a daunting task at best in a world flooding with information—then their leaderships could not retain their power.

World markets proved to be much more efficient in the transaction of commodities than closed hierarchical systems.

Before the threshold to the latest phase of the information revolution was crossed in the mid-1970s, facilitating global markets, it was not at all clear that the closed, centrally controlled economies of the communist world were inferior to the free-market economies of the West. Some in the West feared that central control could lead to more efficient or effective use of resources, particularly for military uses. It took the emergence of global markets to demonstrate that free markets would bury hierarchical structures in the race for the efficient distribution of commodities and the expansion of economies. And, ultimately, the ability to support healthy militaries depended upon healthy economies.

This transformation of the world by interrelated developments—the collapse of closed societies, the abundance of information, and the globalization of economies—will doubtlessly change the nature of conflict. The collapse of the closed societies has unleashed suppressed ethnic conflicts. Abundant information and global markets have facilitated the proliferation of weaponry and grievances. But more importantly, all these developments have transformed the ends or purposes of war.

The wars of colonial and industrial nations have typically been about the taking of land and its resources or plants and their workers. World War II and the Persian Gulf War were such wars. Germany invaded Poland for *Lebensraum;* Japan invaded Southeast Asia for its rubber and oil resources; Iraq sought the territory and resources, first of Iran and then of Kuwait. As the Soviets defeated Germany, they sought German factories and workers as their prize. The United States has defined its policies and military to fight such wars of aggression and, for the most part, has fought them successfully.

But new kinds of conflicts are emerging that are not about these traditional ends or purposes, and American policies and its military have fared less well in them. More conflicts are about externally imposed divisions of societies (Palestine, Korea, Vietnam, and Kurdistan), self-determination (Algeria and Afghanistan), and ethnic grievances (in the former Yugoslavia and Caucasus). For the most part, the intervening or imposing nation-states have not been suc-

cessful in quelling or resolving these conflicts. This is not to say that traditional types of wars between nation-states over territory or resources are obsolete, only that new types of conflict are emerging as the norm, and they will test the capabilities of those military organizations configured mainly to wage traditional types of war.

The abundance of information has revealed new geopolitical fault lines and instabilities and has empowered new political actors who hitherto had enjoyed little influence on the world stage. International connectivity—in communications, commerce, and transport—has facilitated the proliferation of modern weapon systems. Proliferation is occurring with both conventional weaponry and weapons of mass destruction.[7] It is easy for buyers and sellers to connect in the global market.

The principal effect of these trends is the empowerment of nonstate actors in international conflict. As modern weapons become easily obtainable and the traditional nation-state advantages of sovereign territory and industrial capital decline somewhat in their importance, nonstate actors will gain the capability to engage nation-states in conflict with some hope of winning their less traditional objectives. Nonstate actors have the advantage of being able to compose themselves in the form of "distributed, multilocated" threats to nation-states. By assuming a transnational quality, nonstate actors will be hard to "fix and destroy." Their lack of a territorial base will make them elusive opponents—difficult to threaten and almost impossible to deter in a conventional sense. Some of these realities can already be seen in the current activities of international terrorists, separatist movements, and organized crime syndicates.

A SPREADING MISSION SPECTRUM

The spectrum of missions the U.S. Army will be called upon to perform in the future will broaden. The workshop participants believed that although the information revolution may not eliminate the need

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[7]For a now somewhat dated look at nuclear weapons proliferation, see Leonard S. Spector and Jacqueline R. Smith, *Nuclear Ambitions: The Spread of Nuclear Weapons, 1989–90,* Boulder, CO: Westview Press, 1990. For a broader look at the proliferation problem, see Brad Roberts, "From Nonproliferation to Antiproliferation," *International Security,* Vol. 18, No. 1, Summer 1993, pp. 139–173.

for the U.S. Army to fight and win MRCs, it will also thrust new missions upon the Army, vexing missions that could force the Army to change parts of its organization and concepts. A forcing function in the widening spectrum of missions comes from the information revolution—the increasing capability of the global media to cover events in remote areas of the world in near real time. A large public audience in the United States and the West has easy access to graphic images of suffering in parts of the developing world undergoing political turmoil and/or humanitarian disaster. The impact of natural disasters—floods, earthquakes, and famines—as well as the humanitarian consequences of failed nation-states, communal violence, and warlords are now plainly evident for the world to see. U.S. policymakers can be forced by political pressures from an increasingly diverse and informed public to take action in response to television images.[8]

The power of media images to generate military missions has a major implication for the future of the U.S. Army's structural balance between combat and supporting elements. Since World War II, the American military has thought of itself as being in the force projection "business." Force projection has always required supporting infrastructures to be projected as well, but the image and focus was on force projection as the sharp point of the spear rather than infrastructure projection. Indeed, military power projection has become almost synonymous with force projection, when in fact power projection has always depended upon being able to project both forces and infrastructures.[9] The growing sector of the mission spectrum—disaster and humanitarian assistance, peace making, keeping, and enforcement—requires more infrastructure than force projection. Even the force projection requirements for such missions are more likely to be in the form of constabulary rather than combat duties.

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[8]There is a growing literature on the different types of "nonstandard conflict" arising in the developing world and the former Soviet bloc. Some examples of this literature are Lawrence Freedman, "Weak States and the West," *The Economist,* September 11, 1993, pp. 38–40; Gerald B. Helman and Steven R. Ratner, "Saving Failed States," *Foreign Policy,* No. 89, Winter 1992–93, pp. 3–20; and Stofft and Guertner, *Ethnic Conflict,* op. cit.

[9]For example, the projection of military forces onto the European continent in the Normandy invasion of World War II required a prior, enormous projection and buildup of infrastructures in England.

Some infrastructure projection missions—like those for domestic disasters—will occur in fairly orderly environments, but even more will take place overseas in anarchical venues where nothing constructive can be accomplished until civil order is restored. Order restoration requires Army forces to control local violence, keeping it below some threshold of acceptability. In many cases, it will not be practical to try to eradicate all civil violence, since the forces or measures required to do so will be beyond the tolerance of a watching American public. Violence control or suppression for the Army will increasingly come to resemble the work of many big-city police departments in the United States. These departments are often undermanned and cannot hope to eliminate all violence in their jurisdictions, and therefore they focus their energies upon the more limited goal of violence reduction and containment to acceptable levels.

This kind of mission, which seems likely to increase rather than shrink in the future (this statement would seem to be justified by the recent surge in U.S. Army infrastructure projection operations, e.g., support engineers building roads in Somalia, water purification units deployed to Rwanda, and civil affairs teams supervising rural development in Haiti), poses a serious challenge to Army values as they have evolved since World War II. Throughout the Cold War—and especially during the last two decades—the Army has sought to inculcate all its people with the "warrior ethic," in the belief that the primary mission of the U.S. Army is to fight and win large conventional wars. Thus, as infrastructure projection missions become more salient, the Army faces two troubling challenges:

- **Structural:** Whether the supporting units required for infrastructure projection, which have traditionally been sized by the needs of the combat forces, will in the future have to be sized by the changing demands of the mission spectrum.

- **Values:** Whether the focus of the Army will remain on its readiness to fight and win wars and the warrior ethic or shift toward a broader conception of military service and an ethic of military professionalism in many roles.

WAR AS THEATER

After the first day of the workshop, one of the participants[10] offered a metaphor for warfare in the information age:

> War in the future may take on many of the characteristics of improvisational theater. The military will find itself on a stage with other actors, before a watching world and domestic audience, without a shared script, and little control over the other actors or the audience reactions.

Although any metaphor can be taken too far, this one struck the workshop participants as being particularly apt for capturing the coming environment and rich in its implications for the future. Terrorism has long been recognized as theater more than warfare: acts of terrorism are aimed at their effect upon an audience more than its victims. That the information revolution could be causing warfare to trend toward theater seemed to be a new and interesting idea to pursue.

The metaphor was not proposed as another call for the U.S. military to be more aware of public relations as a dimension of war; the Pentagon and the Army clearly understand that message. In Desert Shield/Desert Storm, the U.S. military was quite aware of the importance of public relations to the conduct of its effort in the Persian Gulf. Rather, the metaphor suggests that planning and scripting military operations in the future will become increasingly more difficult and problematical than they were in the Persian Gulf War. Even there, the metaphor could be seen in the abrupt policy changes when that war changed from "good theater" (bombs going precisely down building airshafts) to "bad theater" (bombs penetrating a bunker that also sheltered civilians and the so-called highway of death leading out of Kuwait City).

The metaphor may be most pertinent to ground forces because they are involved in the forms of conflict that are likely to remain the most accessible to the news media, and which tend to be more intimate,

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[10]Steven C. Bankes, a RAND information scientist and author on the implications of the information revolution.

human, and graphic than the engagements of air and naval forces. Modern telecommunications links make it likely that all American ground combat actions—whether large-scale operations like Desert Storm or small squad-sized fire-fights as in Mogadishu—will be televised globally in real time. Events may force commanders to act extemporaneously to prevent a situation from becoming "bad theater" that could quickly turn the Army's "audience" (the American polity) against the mission. In Somalia, Americans watched "good theater" (soldiers feeding children) turn into "bad theater" (an American body being dragged through the street). Bad theater produces policy changes by audience demand.

The war in Vietnam evokes the metaphor. The North Vietnamese may have appreciated their improvisational theater role better than their adversaries. The Tet Offensive in Saigon in 1968 was an example of "bad theater" for the U.S. Army. The images of the U.S. Embassy being stormed by Viet Cong sappers after almost three years of intense Army operations in South Vietnam shocked audiences at home. Whatever the facts of the offensive or the balance of forces, the American audience expected a different scene; the pictures said that the reports of American successes could not be trusted. Throughout the war, the Army's inability to respond to events by departing from its "prepared script" of attrition warfare contributed to American disenchantment and eventual withdrawal from that conflict. Today, the information revolution has created a larger audience for each of the Army's performances; it also gives the Army less time than ever before to adapt its script to avoid an unfavorable scene.

As modern conflict acquires many of the characteristics of improvisational theater, the U.S. Army will need to learn how to adapt the script rapidly. This does not imply that censorship of the media is necessary or desirable, only that the Army should realize that the media images emanating from a given combat action may be more important than the action's outcome. Adaptability, not scripting, is the key to success in improvisational theater. The workshop participants agreed that the level of "script adaptability" embedded in Army plans will increasingly be the predictor of success or failure for its military operations.

The improvisational theater metaphor assumes a special importance when the Army must engage a nonstate actor. Aggressive nation-

states, like Iraq, are easily cast as villains. But nonstate actors pursuing nonstate objectives, such as self-determination, may not be so easily typecast. Then there is the risk that sympathizers will work through the news media to cast the military intervenors as the villains. The enormous relative power of the United States automatically inclines audiences to be critical of its actions; it is easily made into a villain for many in the world audience. This kind of "casting" by the partisans in a conflict playing to an audience is all too evident in Bosnia. And since the audience is increasingly diverse in its origins and affiliations, even within the U.S. public, the chances that any combatant will find an audience are increasing. To be made the villain in the play is almost certainly to be made the loser.

Finally, the improvisational theater metaphor offers a chilling warning for the Army if it is called once again onto the stage in large-scale domestic disorders that exceed the resources of local law enforcement and National Guards. In the information age, such a contingency will be a "command performance" for the Army under the intense scrutiny of the American public. It will be a media event, where every good and bad scene will reverberate within the society and its military. It will be a performance above all performances in which the Army will want to be proud of its restraint and control, of its competence and good sense, and of its training and preparedness. "Bad scenes" coming out of a domestic disorder could severely damage both the Army as an institution and American society as a whole. It is the theater to which the Army least wants to be invited, but the one by which it might be most quickly and severely judged by an American audience.

OPERATIONAL AND ORGANIZATIONAL CONCEPTS

The workshop participants considered several dozen operational and organizational concepts that they thought were

- Different from the Army's current concepts,

- Stimulated or facilitated by the information revolution, and

- Of sufficient merit to note and discuss.

Of those, the authors have selected six that they judged to be representative of the ideas raised in the workshop, distinct from one another, and worthy of presentation in the summary briefing of the workshop to TRADOC and in this report.

Although the workshop sessions were specifically organized to look for operational and organizational concepts appropriate to both MRCs and LIC operations, those distinctions were not helpful to the discussions. The participants found that their thinking was neither facilitated nor constrained by consciously addressing levels of conflict. Instead, in brainstorming fashion, they used one concept or problem to stimulate consideration of another. Similarly, although the participants were encouraged to look for concepts at the operational and tactical levels, most of their thinking remained above the tactical level—at the strategic and operational levels. That higher level of conception was probably an artifact of the limited tactical experience and academic orientation of most of the workshop participants.

The six operational and organizational concepts presented in this report are

- Soldiers as Sensors,
- Information Carousel,
- Agile Defense/Lodgment,
- Network Army,
- Franchised Combat Units, and
- An Army of Armies.

These six concepts are representative of operational and organizational concepts, both pure and mixed. Two of the concepts (Soldiers as Sensors, Agile Defense/Lodgment) are purely operational concepts; they deal exclusively with different ways of using forces. Two (Network Army, An Army of Armies) are principally organizational concepts; they are about new ways of structuring future forces. And two are hybrids of operational and organizational changes: one (Information Carousel) is a different organizational concept for information that requires changes in operational command and control, and the other (Franchised Combat Units) is a different operational concept that requires changes in organization. Collectively, they cover the spectrum of the ideas pursued in the workshop.

None of the concepts were examined in any detail by the workshop participants; the emphasis was on identification and rationale, not on feasibility or effectiveness. If it was not obvious to the participants, the proponent for an idea was asked to explain what that concept had to do with the information revolution—a challenge that tended to suppress "pet" ideas for improving the Army that had little or nothing to do with the subject of the workshop. Each of the six concepts described below is expressly rooted in developments of the information revolution—either in new capabilities or in new patterns of enterprise.

SOLDIERS AS SENSORS

The "soldiers as sensors" idea arises from the observation that a gap is opening between the rapidly developing computing and communications technologies on one hand and sensor technologies on the other. Computer and communications capacities are doubling

- Roots in the information technologies
    - Continuing exponential growth in computing and communications capacities
    - Relatively slower growth in sensing capabilities

- Concept
    - A soldier on the battlefield may become more valuable as a sensor than as a source of firepower
    - Long-range firepower can be centrally controlled but targeted through distributed soldier-sensors

- Implications
    - Organizational: small units, lightly armed?

Sensors are the bottleneck, not communications

Figure 15—Soldiers as Sensors

about every two years; sensor capacities—in numbers or bandwidth or sensitivities—are increasing, but not at such a high rate. If these trends continue, which seems likely, then sensors, not communications or computing, will be the bottleneck on information from the battlefield.

The best broad-bandwidth sensor on the battlefield may be the soldier, not a coupled electronic device.[1] The soldier has eyes, ears, and a nose as sensors that can be intelligently and autonomously directed toward battlefield events of interest to the soldier (for survival) and to higher echelons (for battle management). Aided by augmenting devices, like low-light-level optics, the soldier can, with the human brain, provide the preprocessing of information needed to di-

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[1]A coupled electronic device here refers to a physically responsive device coupled to an electronic signal generator. The device might respond to received light, acoustic, chemical, or heat energy, but its output would be an electronic signal for subsequent processing and interpretation. A microphone and a video camera are coupled electronic devices, as the term is used here.

rect and focus for the acquisition of battlefield information. It may be a long time, if ever, before the broad-band sensor technology in practical systems can match those of the augmented soldier.

Since firepower on the battlefield comes increasingly from long-range systems that can be centrally controlled and precisely targeted, firepower provided directly from the soldier may become less important than the information the soldier can provide to higher levels that can allocate and target the firepower. At the limit, one can imagine the principal role of the soldier on the battlefield as a sensor—a source of information—rather than a shooter. Distributed firepower may become less efficient than centrally controlled firepower because distributed firepower, by its very distribution, may not be at the right place and time; whereas centrally controlled firepower, supported by distributed soldiers as sensors, can be brought to bear in its entirety at the right place and time as judged by the highest levels of command in the battle.[2]

The implications of soldiers as sensors are several: As sensors, their principal mission would be to provide information, not to engage the enemy. That implies that units should avoid detection and contact, if possible; that, in turn, implies smaller, more lightly armed units. Rather than carrying firepower designed to engage and defeat an enemy, their arms might be oriented toward self-defense and escape. Their main equipment would be augmenting devices for their senses (e.g., optical enhancers, navigation receivers) and stealthy communications to relay their acquired information. But the information they would relay to higher echelons might be only a small fraction of what they observe, because one of the greatest values of the soldier as sensor is the soldier's ability to discern what is pertinent. Where

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[2]An idea that is perhaps somewhat similar to "Soldiers as Sensors" is found in Kenneth B. Watman and Daniel P. Raymer, *Airpower in U.S. Light Combat Operations*, Santa Monica, CA: RAND, MR-457-AF, 1994. The authors of this report propose to reduce U.S. infantry casualties in light contingencies by shifting U.S. tactics away from close combat with enemy infantry. This would be done by linking U.S. infantry closely to a new airborne fire support system. U.S. infantry would use a target acquisition system capable of calculating the GPS coordinates of enemy infantry during fire-fights and then feeding those coordinates to circling transport aircraft outfitted with 350-pound glide bombs equipped with GPS guidance receivers. The transport aircraft would then deliver their glide bombs directly upon the enemy units.

automated sensors provide a flood of information—little of which may be pertinent—soldiers can preprocess what they relay.

There is an analog for this preprocessing in the human eye: The eye does not send on all the information it receives to the brain. The retina of the eye consists of not only sensors but enormous numbers of interconnected preprocessing cells that reduce the information received to information that is pertinent to human functioning, such as edges or movement.[3] The brain does not have to deal with the full flood of information coming into the eye, but only with pertinent information processed through the retina. Similarly, with the soldier as a sensor, higher headquarters do not have to cull through the full flood of information available to the soldier, only the pertinent information processed by the soldier.

Detecting and locating the enemy is a challenging tactical mission for the Army. In Desert Storm, this problem was manageable because the desert terrain was favorable for detection of the enemy at a distance from the air and the ground. But in forested, hilly terrain like that in Bosnia, in canopied jungle as in Vietnam, or in urban areas like Mogadishu, finding the enemy, especially when he operates in small units, is difficult at a distance. Once the enemy is spotted, precision-guided weaponry makes successful attack much more likely. While the adage "To be seen on the battlefield is to be killed" may be an oversimplification, it is not far off the future mark when one observes the advances in military technology that are and can be made available to the U.S. Army.

Soldiers as sensors would force a doctrinal emphasis on the areas of military technology (mobile communications and deep fires) where the U.S. Army enjoys advantages over all likely enemies. Simultaneously, it would move Army doctrine away from close combat in infantry meeting engagements, where most American technological advantages are nullified and the heaviest U.S. casualties can be sustained.

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[3]See Hans Moravec, *Mind Children: The Future of Robot and Human Intelligence*, Cambridge, MA: Harvard University Press, 1988.

INFORMATION CAROUSEL

This concept was stimulated by the nature and use of the global computer networks, particularly the Internet. These networks are providing access to anyone with a computer, a telephone line, and software for network entry. The network does not discriminate among its users by nationality, race, sex, or age; anyone may access its riches (and its trash) in information and add one's own. The information that resides on the network can be read by all and "pulled down" into one's computer for storage or further use by anyone who chooses to do so. Any individual can "post" a message to any other individual on the net by address, or can broadcast a message to any and all interested by posting a message to hundreds of public places on the net where others may go to read information posted there on a particular subject.

A seeker of information can post a question on appropriate electronic "bulletin boards" throughout the network. Hundreds, perhaps thousands or, eventually, millions, may see the question, and those with answers or advice may elect to respond. The responses can be

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- Roots in the information technologies
    - Near-universal access to the networks
    - Networks as a living encyclopedia
    - Software to navigate in a sea of information
- Concept
    - A network carousel of battlefield information
    - All units (field and HQ) upload the carousel with location, status, intelligence, directives, per doctrine
    - All units pull down only needed info
- Implications
    - Security: reliance upon technical advantages?
    - Chain of command: foreshortened?

    The edge is in the management of information

Figure 16—Information Carousel

surprising: A question may stimulate answers ranging from replies by world experts on the subject to nonsense and insults. The recipient may have to sort through the range, but the information available in those responses can be the best and latest in the world—for free and with astonishing speed. Some who "surf" on the Internet have observed that it is rapidly becoming the world's best living encyclopedia of information because of the knowledge resident in the minds who monitor and contribute to the net. A printed, published encyclopedia may present the views of one expert; the network can present several. The printed words become dated over months and years; the network words may be the latest available knowledge only hours or minutes old.

But practical questions arise:

Q. How does one know what information is correct on the networks?

A. The same way that humans have always had to sort through information—good and bad—long before the information revolution: by comparing the information received against other information, by checking with experts.

Q. How does one find the needed answer in this overwhelming sea of information?

A. Through software that is increasingly intelligent and resourceful as the searcher's agent—what some have called "know-bots"—software that will locate, sort, and retrieve the desired information if it is available on the net.

Q. How does one avoid being deluged by a sea of responses when there is so much information available?

A. In the same way that one conducts a library search: By starting with a selective search and broadening its parameters until the amount of information acquired meets one's needs.

With modern communications and computer technology, it has become possible to put all the real-time data on location and status for every American military unit in theater into a network automatically. Software exists that will allow users to "pull down" only the data they seek or are "open" to receive. Network architecture could enable a

theater commander to create a "living encyclopedia" of current location and status information for all friendly (and conceivably also for many enemy) units in the theater. The important question for the Army is not the technical feasibility of creating such a network, but who should be granted access to it—a hierarchical issue, not a network issue.

In the information carousel concept, all who could use or contribute information to the net would have access. The metaphor is a carousel of information—very much like the rotating clip wheel between the kitchen and dining room in a restaurant, where orders for the kitchen can be put up and pulled down. The effectiveness of the Internet and the richness and currency of its information suggest that universal access is its strength, not its weakness. But near-universal access for the Army may be troubling for several reasons:

- It runs counter to traditional Army hierarchical command and control concepts, where information is increasingly aggregated and filtered as it proceeds up the chain of command. The information carousel implies that, in principle, the private on the battlefield may enjoy the same access to information on the network as the theater commander.

- It relies on information pull rather than push. Instead of pushing selected information downward to the troops (i.e., telling them only what they "need" to know), they may have access to the information they think they need or want. One potential problem that may arise here is "battlefield distraction," where small unit commanders may be tempted to spend too much time watching events unfold around their unit rather than focusing on their own specific sector.

- The information on the net might be compromised (i.e., read or tainted) with near-universal access. The enemy might be able to know what the theater commander knows or implant deceptive information on the net.

The workshop participants worked their way through each of these potential concerns and concluded that the potential benefits of "information carousel" outweighed the potential costs. They recognized that near-universal access to information was a major depar-

ture for the Army, but such departures will have to be confronted as the information revolution works its way through traditional hierarchically organized institutions. Information pull rather than push is a powerful distinction in dealing with the flood of information, and failure to exploit that principle could put the Army at a disadvantage with those who do.[4] The potential battlefield distraction problem is certainly worthy of note, but there is no reason to believe that it could not be avoided by rigorous training programs that instruct small unit commanders in methods of filtering out unnecessary information that they might sometimes pull down from the net, so that they can retain focus on their immediate sector of operations. Although the workshop participants were divided on the risks of security compromises, there was a view that encryption technology and the Army's superior ability to exploit the information on the carousel were sufficient edges.

AGILE DEFENSE/LODGMENT

One of the more noticeable trends in international business today is agility—the growing ability of multinational corporations to rapidly shift production, investments, and personnel from one country to another in response to changes in tax codes, interest rates, inflation, etc. This new ability to operate flexibly across borders is enabled by the growth in the information technologies.

A parallel concept for the Army was called agile defense, or lodgment, in the workshop. It assumes that the Army can configure itself to be agile and effective in forced-entry scenarios where the available U.S. ground forces are outnumbered and too small to form a solid line of defense or an integrated lodgment. It is an effort to compensate for very low force-to-space ratios without having to resort to a defensive line consisting of scattered strongpoints. The essence of the concept is the presumption that superior information systems

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[4]Observers at the National Training Center cited battlefield situations where forces were defeated because their information was pushed rather than pulled. Pushed warnings came too late, whereas the warning information would have been posted and available to the forces if it could have been pulled down without intervening command layers.

- Roots in the information technologies
    - Communications and automation permit more flexible financing, marketing, and production options for rapidly changing circumstances

- Concept
    - When denied the option of overwhelming force, use geography and superior C3I for expanded choices in applying fires and strikes
    - Locate fire and strike forces back, in sanctuaries

- Implications
    - Equipment: UAVs, mines, NLOS-like, stealth?
    - Doctrinal: especially for light, early-entry forces?

Using technology to enable new tactics

Figure 17—Agile Defense/Lodgment

will allow the Army to fight flexibly—to engage the enemy only at favorable places and at favorable times.[5] As the post–Cold War era moves forward, the Army may be forced to consider more flexible and agile concepts for MRCs, where the United States is likely to find itself projecting its military power over long distances into the theater of operations.

The agile defense or lodgment concept could involve a number of tactics, such as:

- Initially keeping as much distance as possible between U.S. forces and the enemy, while keeping the enemy in range of the Army's deep fire systems.

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[5]Ideas similar to this can be found in Richard L. Kugler, *NATO's Future Conventional Defense Strategy in Central Europe: Theater Employment Doctrine for the Post–Cold War Era,* Santa Monica, CA: RAND, R-4084-A, 1992, chs. 3 and 5.

- Fighting a "shoot and scoot" standoff battle in the early days of a war, with the intent of inflicting heavy losses before disengaging and moving to another location.

- Employing large numbers of non-line-of-sight (NLOS) anti-armor missiles, stealthy light combat vehicles, and advanced mines, such as the wide-area mine (WAM) system.

Once a critical mass of heavy ground forces was established in theater, agility could take other forms. The Army could supplement its initial standoff tactics with the periodic use of mobile strike forces located in sanctuaries in the rear of the battle area. After having completed a rapid counterattack, these mobile forces would not attempt to hold any territory, instead returning to their rear area sanctuaries until the next opportunity appeared. Improvements in the U.S. ability to track and target large armored units (e.g., with the JSTARS airborne side-looking radar system) should make linear fronts or integrated positions unnecessary for American heavy forces in armored warfare. If the location of enemy armor can be known with some accuracy, as seems increasingly likely, American heavy forces could be kept back out of the range of most enemy firepower until the moment when they could be used to greatest effect. When an opportunity for a counterattack appeared, these forces could be brought to bear quickly to press their attack.

NETWORK ARMY

Another emerging practice in the business world (enabled by information technology) has been called "infinite, instant partnering." It refers to how increasing amounts of business information are being transacted between an infinite number of partners, any two of whom may partner instantly and for only an instant, to trade needed information. After their transaction, they may never partner again, but they go on to partner with others, trading other information they need. Geography and distances count for little. Their connectivity in almost infinite seas of information and potential partners is essential to the process. Distributed commercial enterprises operating on this basis are at no disadvantage with respect to companies that have all

- Roots in the information technologies
    - Communications permit *distributed* enterprises
    - Geography and location count for less
    - Rise of "infinite, instant partnering"

- Concept
    - Minimum functions located in the combat theater
    - Draw upon *entire* Army for support as needed
    - Send the problems (mostly about information) to the experts, don't bring the experts to the problem

- Implications
    - Mobility: reduced transport requirements?
    - Organizational: more fixed-site specialization?

    Mobility is the Army's most costly burden

Figure 18—Network Army

their units located in the same region. Indeed, as described in Chapter Three, they may even be in a better position to react rapidly to changes in the global markets.

The notion of infinite, instant partnering can be translated to the concept of a network army. It would be an army networked electronically so that its many components, elements, units, and functions could engage in infinite, instant partnering, regardless of their location. It could allow the Army to be much more economical in what it projects forward into the theater of operations. For example, a network army could deploy only its essential functions to an overseas theater and leave at home many of its C^3I, logistics support, intelligence, and medical functions.[6] Many headquarters, support, and sustainment issues can be solved by experts working in CONUS, pro-

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[6]Fiber optics and lasers will permit intricate surgery to be performed remotely through telecommunications links anywhere in the world—by the best surgeons in the world. Field hospitals will need only provide the surgical environment and general surgical skills; many of the Army's top medical specialists can stay at home where they can be available to hospitals worldwide.

vided they are connected electronically and made easily accessible to each other. The concept is more than expanding communications; it is about allowing and facilitating individuals to partner freely and quickly to solve their problems.

An obvious advantage of a network army is that it reduces the strain on strategic lift; it makes available more space on limited airlift and sealift assets for the movement of combat forces. Mobility, both strategic and within the theater, is arguably the Army's greatest burden. Strategic mobility is a burden for the Army because it is provided by the other services and is, therefore, likely always to be less than the Army needs. Theater mobility is a burden because the Army spends more to develop, acquire, and maintain its vehicles for theater mobility than on any other capability. Anything the Army could do to reduce this burden—by needing less strategic lift or by needing less theater mobility—should be helpful in a time of reduced budgets for all of the American military services.

There is a basing implication lurking in the concept of a network army: For the U.S. Army, it could facilitate permanent CONUS basing for many units and capabilities that would not need to move forward to the theater, but could instead remain at home to support the theater operations through electronic nets. These fixed centers would be nodes of expertise or knowledge that could rapidly connect with their overseas and other CONUS-based partners. For example, it might be advantageous to concentrate specialized medical expertise at one site, intelligence functions at another, and vehicle spare parts management at still another. This type of arrangement could make for more stable basing for many supporting units and functions. Although such stability would run counter to the Army's tradition of moving its people regularly for career development, it could also be a money-saver at a time when funding is short.

FRANCHISED COMBAT UNITS

The flattening of organizations by removing management layers and increasing managers' spans of control is but one of many of the information revolution's accepted consequences for businesses. Franchised businesses are not new, but the efficient organization of fran-

- Roots in the information technologies
    - Communications and automation now permit a broader span of control across fewer levels
    - Global headquarters and local franchises

- Concept
    - Restructure the Army around smaller, self-contained combat units associable with a generic territorial franchise
    - Franchise scope set by unit's weapon ranges?

- Implications
    - Organizational: only two levels: HQ and field?
    - Doctrinal: combined arms at a lower level?

McDonald's goes to war?

Figure 19—Franchised Combat Units

chises has been facilitated by enhanced communications.[7] Instead of management through geographically bound layers—local, regional, state, national—individual franchises can be managed directly from an international headquarters. A single point of management, aided by information systems, can manage the needs of hundreds or even thousands of franchises. The franchises may be supplied by regional suppliers, because of the costs of transporting perishable goods, but the regional suppliers can also be managed directly from an international headquarters that is automatically monitoring franchise consumption and inventories.

In the commercial world, the prototypical example of franchising is the McDonald's chain of fast food restaurants. McDonald's consists of a central corporate headquarters and a large number of franchises

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[7]And computers, as any visit to a McDonald's will reveal. Drink dispensers are computer controlled, so that the server need only place the cup and press the button—a computer will take care of the proper filling. One can speculate that it won't be long before even the server's movement of the cup will be taken over by computer-controlled robotic operations. The same can be said for the french fryers.

scattered around the globe. Each franchise has a similar concept of operations for each type of prospective contingency, but each is self-contained and has a fairly well-defined territorial area of responsibility. Intermediate layers of organization tend to be "overhead" and are kept to a minimum.

Translation of these information-driven developments to military concepts suggests that combat units might operate as franchises—a territorial franchise based upon the unit's radius of autonomous action. The concept might draw upon many of the same themes of the Swedish defensive cell concept described earlier, except that the franchises might be designed and employed for offensive as well as defensive operations.

For franchised combat units, the scope of a franchise would be set by the unit's weapons ranges. The franchise units would be combined arms packages, each including increments of armor, attack helicopters, mechanized infantry, tube artillery, engineers, air defense artillery, and support units. Unlike the Swedish cell units, these franchised units would be capable of deep offensive operations over long distances. Long-range missiles might, like suppliers for fast-food franchisers, be centrally controlled by the single franchise headquarters.

This concept might be most appropriate for situations where the U.S. Army finds itself in a large rural theater of operations, fighting against a widely dispersed opponent with medium to low technological capability. Indeed, the war in Vietnam might be a very good historical foil against which the concept of franchised combat units could be examined in greater detail. Figuring out how to do better in that kind of war could still be a good investment in the future—given that the United States would still probably have problems dealing with an insurgency-like conflict.

AN ARMY OF ARMIES

As the information revolution facilitated global markets, many businesses have evolved into niche enterprises. Niche enterprises focus on one core competency and become so proficient at it that their services or goods are in demand throughout the entire global marketplace. Niche enterprises survive much as ecological niches in a

- Roots in the information technologies
    - Communications and automation encourage specialized enterprises that fill niches
    - An emphasis on core competencies

- Concept
    - Restructure the Army around several rather than one core competency
    - Several *cooperative* armies — for land combat, infrastructure projection, and constabulary

- Implications
    - Organizational: elevate priority resolutions?
    - Doctrinal: new doctrinal fields?

Several armies with equal voices right to the top

Figure 20—An Army of Armies

hostile environment by making themselves more valuable to their clients than vulnerable to their competitors.

As its scope of missions widens, the U.S. Army cannot hope to be the best military service at all things—even on the ground. If the Army makes its core competency the fighting and winning of the nation's wars, then it must accept that it may not be as proficient at other missions that are almost certain to come to its doorstep. That trade-off may be acceptable to the Army, but it may not be to all those whom the Army serves, and who may expect the Army to be more proficient at the more likely and frequently assigned tasks in operations short of war.[8] The ideas of core competencies and niche enterprises in the business world naturally evoke the concept of an

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[8]Operations short of war is the terminology used in Title X of the U.S. Code, which sets forth the responsibilities of the military services. Different terminology—military operations other than war, or MOOTW—has become common, but the term written into the law governing the American military's basic responsibilities for war, mobilization, and operations short of war would seem to be adequate.

army of armies—an army composed of niche armies, each with a distinctive core competency.

As an example of the concept, one army could be designed for conventional land combat, another for infrastructure projection (required both to support land combat and for relief missions), and yet a third for constabulary functions (frequently required for the aftermath of combat, for relief missions, and for peacekeeping). Each of these new "armies" would have its own support force structure. The principal advantage sought in this example is a greater Army proficiency and readiness for missions in the area of operations short of war. Instead of trying to reconcile warfighting, humanitarian assistance, and peacekeeping ethics in a single army, each of the three armies in this example would be free to develop its own doctrine, ethic, and core competency. The difference might be more than improved proficiency in several missions; it also might mean less confusion for soldiers about their identities and purposes when assigned to a broadening mission spectrum.

There are obvious risks to such a radical restructuring of the Army. An army of armies would create internal competition for funds and perhaps even for its leadership—harkening back to days when engineers or even medical personnel were candidates for the Army chief of staff. For the dominant faction of the Army, an army of armies would signal a dilution of its stature and a rise in the stature of other factions. The dominant faction would be expected to resist such a change in its fortunes and to succeed in that resistance. So, an army of armies is not a concept that is likely to "fly" in today's Army; but then neither would niche enterprises have appealed to the conglomerates of the business world before the information revolution and global markets. An army of armies may be a concept whose time has yet to come. Unfortunately, as too many businesses have learned, when the time does come, it may be too late to change.

AFTERTHOUGHTS

Several themes evolved during the workshop discussions that did not respond directly to the workshop objectives. They are collected here as afterthoughts—ideas or issues that the workshop participants thought were too important to be left out of the record. In effect, they represent the unsolicited advice of the participants that may not be welcomed by the workshop sponsors, but cannot in good conscience be withheld.

WHITHER CONSTABULARIES?

Constabulary forces are formally defined as "an armed police force organized on military lines but distinct from the regular army."[1] As the U.S. Army is called upon over the long term to become increasingly involved in restoring civil order, disaster relief, stabilizing societies, and peace operations, it may find that its military police units are too small to handle the demands for constabulary functions. Constabulary forces are not new to the U.S. Army: Its role in the American West during the last half of the 19th century was that of a constabulary. Early in this century, in the wake of the Spanish-American War, the Army's Philippine Constabulary played a key role in the pacification of the Philippines. After World War II, the Army established a special constabulary force to maintain order in its occupation zone in Germany. If the restoration and maintenance of

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[1]This definition is from *Webster's Ninth New Collegiate Dictionary,* Springfield, MA: Merriam-Webster Inc., 1990.

civil order evolves into a primary mission for the U.S. Army, the resurrection of the constabulary idea may be warranted.

Workshop participants identified four ways in which the Army could foster the establishment of constabulary capabilities:

- Set up constabularies made up of locals in other countries through the use of Army training missions. Before this could happen, however, U.S. law would have to be changed, because it currently prohibits the Army from such activity.

- Embedding constabulary capabilities within its own active duty force structure. This is akin to the "army of armies" concept, the merits and disadvantages of which have already been outlined.

- Encourage the development of a U.S. constabulary outside of the Army that could be used for operations abroad. Although this option might be the path of least resistance for the Army, over the long run, an independent constabulary force could become a competitor to the Regular Army for funds and skilled personnel.

- Convert portions of the Army Reserve and National Guard into a constabulary force. One shortcoming present here is that this might force the U.S. President to order a partial mobilization of the reserve component every time the nation becomes involved in an operation other than war.

SOME WARNINGS

As the Army embraces information technologies and confronts a potential revolution in military affairs (i.e., the concomitant shifts in concepts and doctrine along with new technologies and hardware), there may be a significant risk of missing the forest for the trees. There may be an understandable tendency to focus on what these changes mean for the Army rather than how they are changing the Army's environment. For example, much of the current military efforts to adapt to the information revolution center on exploiting the technologies for

- the improvement of current operations,
- current concepts of warfare, and

- current clients and their objectives.

Although all of these are changing and will change through the information technologies, changes in the last aspect may be more fundamental and neglected. The Army's attention to concepts of military operations and warfare could lead it to be blindsided by even greater changes in its clients (the American public and the U.S. government) and their objectives. The information revolution could change the nature of war more than the nature of operations, and it is likely to change American society more than it will the Army.

The information revolution is changing the nature of international conflict. Even though the revolution is a technological one, the changes it will bring to warfare will not be mostly in the form of new technology. Instead, it is altering the actors on the stage, the audience that can watch, and, hence, the objectives of conflict. Nonstate actors are seeing their relative strength on the international stage increase. They will certainly not be able to militarily challenge nation-states on an equal footing, but they also will not challenge a nation-state in the same way that another nation-state would. The most common threats to nation-states in the future may not be other nation-states, and their challenges are not likely to come in the form of regular, conventional military forces.

The information revolution is shaping a world in which more and more of the contingencies that will confront the U.S. Army will not be conventional wars. An increasing number of Army operations will have to do with infrastructure projection and violence suppression rather than with deterrence and warfighting. If the Army fixes itself too firmly on fighting and winning the nation's conventional wars as a way to husband its scarce resources, it may find that its market—like that of the mainframe computer makers—is narrowing. Perhaps the Army's best chance for a successful future in the information age lies in new organizational and operational concepts that respond to a new and different world, rather than in new technology for an old world. This is not to denigrate force modernization, but a focus on adapting technology as the principal answer to the Army's problems will miss the nature and immensity of the challenges. Doctrine is the Army's best vehicle to encourage new organizational and operational concepts that will be responsive to a future world whose only certainty is change.

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